CHAPTER 10

SPECIAL TOPICS

The purpose of this chapter is to compare the environmental and related impacts which would result from implementing the reoperation scenarios proposed under the Folsom Modification Plan and the Folsom Stepped Release Plan to the Baseline condition which existed prior to Folsom Reservoir being reoperated in accordance with the agreement between SAFCA and Reclamation.

FEDERAL PARTICIPATION IN PERMANENT REOPERATION OF FOLSOM RESERVOIR

Implementation of the temporary agreement between SAFCA and Reclamation to change the operation of Folsom Reservoir from the Baseline condition of 400,000 acre-feet of fixed flood storage reservation to a flexible storage reservation of between 400,000 and 670,000 acre-feet has resulted in impacts to several resource categories. SAFCA has provided mitigation for the impacts which would result from the 5-year period of the agreement. The operation of 400,000 and 670,000 acre-feet is the No-Action Alternative to which the action alternatives are compared for determining project impacts and mitigation requirements.

However, this results in segmenting the impacts of changing the operation from 400,000 to 400,000/670,000 acre-feet for No-Action, or to 475,000/720,000 acre-feet of storage for the Folsom Modification Plan, into smaller increments, none of which are significant. The impacts from permanently reoperating Folsom Reservoir using the rule curve have been identified and evaluated and are discussed in chapter 6 for the No-Action Alternative (the impact discussion also covers the reoperation component of the Stepped Release Plan, since reoperation under this plan is the same) and chapter 7 for the Folsom Modification Plan.

Should the Federal Government authorize a project which includes a permanent reoperation component, mitigation would likely be provided for the impacts of changing from the Baseline condition of 400,000 acre-feet of fixed storage to the Stepped Release Plan (400,000 to 670,000 acre-feet) or the Folsom Modification Plan (475,000 to 720,000 acre-feet) as these would be the impacts for which mitigation would be provided should either plan become the authorized Federal project.

Each of the candidate plans were evaluated against the No-Action Alternative. The No-Action Alternative includes changing the flood control operation of Folsom Reservoir

from 400,000 acre-feet of fixed storage to a variable operating curve of between 400,000 and 670,000 acre-feet of space, depending on the amount of incidental storage space available in the upstream private reservoirs. The Folsom Modification Plan and the Folsom Stepped Release Plan both recognize that this reoperation of Folsom Reservoir would either continue unchanged under the Stepped Release Plan, or be increased under the Folsom Modification Plan. However, neither plan identifies or evaluates the environmental consequences of permanently reoperating Folsom Reservoir to the 400,000 to 670,000 acre-foot level.

If either of these alternatives becomes the alternative selected for Federal participation, it is probable that the non-Federal sponsors would request that the costs of permanently reoperating Folsom Reservoir to 400,000 to 670,000 acre-feet of variable storage be included as a project feature. Should this occur, the costs for mitigating for those impacts would be included. This section identifies the impacts which would result under both plans and identifies potential measures to compensate for the losses associated with permanent reoperation. This analysis uses the 400,000 acre-foot operating rule curve as the baseline condition and compares the effects of permanently instituting the 400,000 to 670,000 acre-foot flexible flood storage operation (No-Action Alternative) to it, thereby characterizing the effects of permanent reoperation. The effects of permanently instituting the 475,000 to 720,000 acre-foot flexible flood storage operation (Folsom Modification Plan) are summarized following the discussion related to the No-Action Alternative.

COMPARISON OF NO-ACTION ALTERNATIVE TO BASELINE CONDITION

Permanent reoperation of Folsom Reservoir using the 400,000 to 670,000 acre-foot flexible storage diagram would result in significant impacts to the same resources discussed for the No-Action Alternative. The following discussion comes from the final Environmental Impact Report/Final Environmental Assessment for the Interim Reoperation of Folsom Dam and Reservoir (SAFCA, Schuster, Water Resources Management Inc., and Beak Consultants Inc., December 1994).

RECREATION

No-Action

Lower American River. This area is used by approximately 6.5 million visitors annually. Boating (rafting, canoeing, and kayaking), swimming and wading, and fishing are important water-dependent recreation activities along the lower American River, accounting for approximately 1.5 million visitors. Approximately 90 percent of all boating and swimming on the lower American River takes place between Memorial Day and Labor Day. Fishing is a year-round activity. The remaining usage is from land-based activities such as bicycling, jogging, and walking.

Boating, swimming, and wading are affected by flows and water temperature. Low flows typically affect boating by reducing stream velocity, so river-travel time and congestion increase. Swimming and wading opportunities can be limited by the number of usable areas along the river, which decrease during periods of low flow, and low water temperatures during periods of high flow.

Fishing opportunities along the lower American River are affected by the abundance of sport fish (chinook salmon and steelhead trout).

Folsom Reservoir. Folsom Reservoir supports numerous water-based activities such as boating, waterskiing, and fishing. The shoreline provides sandy swimming beaches, both formal (with lifeguard services) and informal. Surrounding Folsom Reservoir is a landscape with important scenic, natural, and cultural values. Recreational facilities include camping and picnic areas, boat launch ramps, restrooms, concessions, bicycle and mountain bike trails, and equestrian trails and staging areas.

Most visitation at Folsom Reservoir is in the summer (approximately 2.3 million), when recreation focuses primarily on water-based activities, including swimming, windsurfing, fishing, boating, boat camping, jetskiing, and scuba diving. Winter visitation is substantially lower, and use consists mainly of fishing and passive recreation.

Water-surface elevations directly affect the availability and quality of boat ramps, beaches, berth sites, and other facilities which depend largely on water depth or surface area. As these facilities become unavailable to users, use patterns and visitation are altered. In addition, visual resource values closely associated with the recreational experience are affected by water-surface elevations and influence how, and the degree to which, recreationists use the resources of Folsom Reservoir.

Upper American River. Reclamation contracted with the Department of Parks and Recreation to provide recreation and public-use management services on the lands within the boundaries of the multipurpose Auburn Dam project, known as the ASRA (Auburn State Recreation Area). The ASRA includes 42,000 acres and 48 miles of the American River from the damsite to the Iowa Hill bridge on the North Fork to Oxbow Reservoir on the South Fork. The ASRA is visited by approximately 500,000 recreationists per year.

Its nearness to major population centers and diverse recreation base make the ASRA one of the most-used and significant recreation resources in northern California. Local interest in recreation is very heavy. Bicycling has increased dramatically in the area. There is continuing demand for equestrian trails and other trails. The Tevis Cup horse race and the Western States Run, both 1-day, 100-mile events, use the Western States Trail from Auburn to Squaw Valley. These events draw entrants from around the world. Whitewater boating on the Middle and North Forks of the American River is of State and national significance. Both forks offer overnight camping opportunities, hiking trails, cultural and natural observation sites, and a diversity of difficulty in whitewater rapids from beginning to advanced boating skill levels. The nearby South Fork of the American River offers a less

challenging whitewater experience, and because of the predominance of private lands and development along the river corridor, camping is restricted. The nearest similar "wilderness" whitewater river, providing overnight trips, is the Tuolumne River, about 100 miles southeast of the recreation area. Approximately 72 miles of hiking trails, 66 miles of equestrian trails, and 15 miles of fire road are open to mountain bikes in the ASRA and provide year-round recreation opportunities.

Significance Criteria

Impacts on boating, swimming, fishing, and wading at Folsom Reservoir and along the lower American River were considered significant if changes in flows or water temperature would result in a 10 percent reduction in recreational use when compared to the 400,000 acre-foot condition.

Impacts

Lower American River. For purposes of evaluating the impacts of the No-Action Alternative on recreation in the lower American River, a use model was developed based on minimum and optimum flow and temperature thresholds for boating and swimming. This model was used to compare use patterns under the 400,000 acre-foot condition and No-Action Alternative during the Memorial Day to Labor Day period for all 69 years in the hydrologic record. For boating activities, minimum thresholds would be achieved 78 percent of the time, and optimum thresholds would be achieved 55 percent of the time under the 400,000 acre-foot condition. These figures would decline by 1 percent to 77 percent and 54 percent under the No-Action Alternative.

For swimming activities, minimum thresholds would be achieved 81 percent of the time, and optimum thresholds would be met 52 percent of the time under the 400,000 acre-foot condition. Under the No-Action Alternative, the minimum threshold would be met 82 percent of the time (an increase of 1 percent), and the optimum threshold would be met 52 percent of the time (no change).

Under the No-Action Alternative, temperature and flow fluctuations would result in little change in the quantity and quality of fish habitat relative to the 400,000 acre-foot condition. Because fish habitat would not be substantially affected, it is assumed that sportfishing opportunities would not change from those under the 400,000 acre-foot condition.

Based on this analysis, impacts on recreation along the lower American River under the No-Action Alternative are considered less than significant because the frequency with which important thresholds for swimming and boating would be achieved would be similar to the frequency under 400,000 acre-foot conditions, and temperature and flow fluctuations are not expected to substantially change the availability of sport fish.

Folsom Reservoir. Impacts to Folsom Reservoir recreation were evaluated based on establishing larger reservoir elevations for boating and swimming activities during the peak (April-August) and offpeak (September-March) seasons for all (69) years in the hydrologic record. Activities, measured as visitor days, were correlated to the target elevations based on a use model developed by the California Department of Parks and Recreation. The 400,000 acre-foot condition and No-Action Alternative models were run to generate comparative visitor-day totals. This evaluation indicated that total use during the peak season would decline by approximately 25,000 visitor days, or about 1.1 percent of total use. This would not be a significant impact under the significance criteria established for this impact category.

Reductions in offpeak season use would be numerically smaller, but would constitute a higher percentage reduction for the affected months. However, the total reduction in use for the offpeak season would be less that 10 percent and thus would not constitute a significant impact under the applicable criteria.

Clair Engle Reservoir. Target reservoir storage elevations for recreational activities were established for Clair Engle Reservoir and used to compare use under the 400,000 acre-foot condition and the No-Action Alternative. This comparison showed recreation opportunities based on optimal boat ramp availability and lake surface area would be unchanged. The No-Action Alternative caused recreation opportunities during periods of limited boat ramp availability to decline by 1 percent. This is not considered a significant impact.

Other CVP/SWP Reservoirs. Impacts at other recreation areas within the CVP/SWP system (for example, Shasta Lake, Lake Oroville, the Sacramento River, and the Delta) were not assessed quantitatively because hydrologic modeling output for the 400,000 acre-foot Condition and the No-Action Alternative indicated only small incremental changes in reservoir levels and riverflows.

All boat ramps would be out of operation 1 percent of the time during the peak season and 2 percent of the time during the off-season. Boat ramp availability would be limited 31 percent of the time during the peak-use season and 80 percent of the time during the off-season. Usable surface area for boating would become constrained 13 percent of the time during the peak-use season and 37 percent of the time during the off-season. The lake elevation would fall below the optimal level for boating 47 percent of the time during the peak-use season.

This impact would be reduced to a less than significant level by extending a low-water boat ramp as proposed by Reclamation and SAFCA as part of interim reoperation of Folsom Dam and Reservoir at affected reservoirs.

Cumulative impacts must also be considered relative to impacts associated with the construction or implementation of other similar or related projects. This chapter discusses potential cumulative impacts relative to reoperation through a discussion of similar or related

water supply projects, and discusses potential cumulative impacts associated with the construction features of this project through a discussion of other levee improvement or flood control projects.

Mitigation

No significant impacts to recreation facilities or opportunities were identified for the No-Action Alternatives; consequently, no mitigation is required.

FISHERIES

Baseline

Lower American River. The Baseline in the lower American River is considered to be only marginal for anadromous fish production, especially during low-flow years. Increased water temperature, decreased water quality, reductions in the quantity and quality of spawning gravel, and a decline in hatchery production contribute to this potential reduction of the anadromous fishery resource.

Fall-run chinook salmon continue to be the primary species of management concern in the lower American River. This approach reflects the consensus reached by participants in Environmental Defense Fund et al. versus East Bay Municipal Utility District (Hodge Decision)—a consensus which included as management priorities ". . . maximize the in-river production (that is, spawning, juvenile survival) of chinook salmon in the Lower American River" and ". . . maximize the in-river production of steelhead trout to the extent that it does not interfere with chinook salmon management." However, because NMFS received a petition on February 14, 1994, to list steelhead trout throughout its range in Washington, Idaho, Oregon, and California, the issue of management priorities in the lower American River merits additional discussion.

High water temperature during summer and fall is the environmental factor that is the most limiting to natural production of steelhead trout in the lower American River (Snider and Gerstung, 1986; DFG, 1991c). Historically, steelhead trout migrated upstream to their primary spawning and rearing areas in the upper forks of the American River and its tributaries. In these upper reaches of the American River system, juvenile steelhead trout reared for at least 1 year before migrating downstream to the Pacific Ocean. Cool water temperatures in the upper reaches of the system made this extended rearing component of their life history possible. Today, the historical spawning and rearing areas are inaccessible to steelhead trout, and, due to dam construction, spawning and rearing in the American River system is restricted to the lower American River—an area subjected to elevated water temperatures. Consequently, it is believed that few juvenile steelhead trout survive through the summer and fall (DFG, 1991c).

In addition to the river itself, high water temperatures at the Nimbus Fish Hatchery during late summer and fall are problematic for rearing steelhead trout, even during good water years. High water temperatures promote the growth of disease organisms. Treatments for these diseases are expensive and contribute significantly to the cost and ineffectiveness of raising steelhead trout to yearling size (DFG, 1991c). Currently, modernization plans for the hatchery do not address the problems of high water temperatures during summer and fall at the hatchery. There are no formal plans or processes under way to resolve the problem of high water temperatures (DFG, 1991c).

Folsom Reservoir. Folsom Reservoir operations under the 400,000 acre-foot Condition adversely affect resident warmwater species in two ways. First, the water-surface elevation in Folsom Reservoir is reduced from full pool elevation by an average of 39.3 feet between June and September, a critical time in year-class development. Such drawdowns eliminate an average of 2,567 surface acres of water (25.6 percent of total), much of which is in sheltered coves containing flooded terrestrial vegetation. This loss of juvenile rearing habitat resulting from summer drawdown is believed to have the greatest negative effect on annual production of fish in Folsom Reservoir (D. Lee, DFG pers. comm., 1994). Second, fluctuations in water levels cause dewatering and flooding of nests and reduce the spawning success. As a result, annual production of bass, sunfish, crappie, bullhead, and catfish is low, and the population of these species tends to be marginal compared to those found in similar natural reservoirs that do not suffer such wide fluctuations in water level.

Upper Sacramento River. NMFS has determined that a daily average water temperature of less than or equal to 56 °F is required in the Sacramento River between Keswick Dam and Bend Bridge from April 15 through September 30 to protect winter-run chinook salmon spawning and incubation. NMFS, in its 1993 biological opinion, specified a minimum flow release criteria for October through March of 3,250 cfs at Keswick Dam.

Significance Criteria

For purposes of evaluating the impacts of the No-Action Alternative on fishery conditions, it is assumed that a 10 percent exceedence criteria based on the 400,000 acre-foot Condition would constitute a significant impact.

Impacts

Under the No-Action Alternative, the frequency with which lower American River flows would meet or exceed the Hodge flows would increase by 5 percent in October through February, decrease by 1 percent in March through June, and remain unchanged in July through September compared to the baseline. Chinook salmon spawning flows may improve slightly. In general, flow impacts on physical habitat in the lower American River would be similar to those under the Baseline.

Lower American River. The exceedence frequencies for the No-Action Alternative, the Baseline, and the action plans are compared in table 10-1.

TABLE 10-1

Exceedence Frequencies of Recommended (Minimum) Flows Using Average Monthly Flows for the Lower American River (Hodge Flows)

		Exceedence Frequencies in Months				
Fisheries Impact Threshold Flows	Number of Months (Relevant Period - 70-Year Period of Analysis)	400 TAF (Baseline Condition)	400/670 (No-Action Alternative)	475/720 TAF (Folsom Modification Plan)	400/670 TAF (Stepped Release Plan)	400 TAF (Detention Dam Plan)
2,000 cfs	350 (Oct-Feb)	147 (42%)	165 (47%)	182 (52%)	165 (47%)	147 (42%)
3,000 cfs	280 (Mar-Jun)	148 (53%)	146 (52%)	151 (54%)	146 (52%)	148 (53%)
1,750 cfs	210 (Jul-Sep)	160 (76%)	160 (76%)	161 (77%)	160 (76%)	160 (76%)

Water Temperature Impacts. An analysis of daily exceedence frequencies based on the historical relationship between reservoir storage, lower American River discharge, and maximum daily water temperatures in the lower American River was not required because the alternatives to be analyzed include operation of the temperature control device at Folsom Dam, which is expected to alter the relationship among lake level, discharge, and water temperature.

Chinook Salmon. Under the No-Action Alternative, the frequency with which monthly water temperatures would exceed optimal water temperatures for chinook salmon spawning and incubation in October and November would be increased by 0-2 percent (depending on distance downstream from Nimbus Dam) compared to the Baseline. The frequency with which temperatures at Nimbus Hatchery would exceed 56 °F (based on monthly water temperatures at Nimbus Dam) would increase by 2 percent. Therefore, no significant changes would occur in temperature impacts on in-river and hatchery production of chinook salmon.

Exceedence frequencies would slightly decrease or have no change in the spring relative to the chinook salmon rearing and emigration threshold. Therefore, water temperature impacts on chinook salmon rearing and emigration success would not change significantly relative to the Baseline.

Steelhead Trout. Under the No-Action Alternative, the frequency with which monthly water temperatures would exceed optimal water temperatures for steelhead trout spawning and incubation would decrease by 3 percent at Nimbus Dam and remain unchanged at the downstream stations relative to the Baseline.

As under the Baseline, monthly water temperatures in summer would continue to exceed the rearing threshold in all years. A 2 percent increase or no change would occur in exceedence frequencies relative to the steelhead trout emigration threshold. Therefore, no significant adverse impacts on steelhead trout rearing and emigration success would occur.

American Shad, Striped Bass, and Sacramento Splittail. Under the No-Action Alternative, no changes would occur in the frequency with which monthly water temperatures would exceed spawning temperature thresholds for American shad, striped bass, and Sacramento splittail. Therefore, water temperature impacts on the spawning success of these species would be similar to those under the Baseline.

Flow Fluctuation Impacts. Under the No-Action Alternative, the frequency of flow reductions of 50 percent or more during the chinook salmon spawning and incubation period would remain unchanged in October through January and increase by 1 percent in November through February and December through March. The frequency of 50 percent flow reductions during the steelhead trout spawning and incubation period would increase by 1 percent in January through April and 6 percent in February through May. Therefore, redd stranding impacts on chinook salmon and steelhead trout were considered less than significant.

Potential stranding impacts on Sacramento splittail would be similar to those under the Baseline. The frequency of reductions in river stage of 1 foot or more would decrease by 1 percent during the principal splittail spawning and early rearing period.

Folsom Reservoir

Black Bass Spawning and Rearing Habitat. Median differences in black bass habitat values would be zero to 1 percent. No significant changes in black bass spawning and rearing success would occur.

Spawning Success of Warmwater Fish. Under the No-Action Alternative, the frequency of reservoir drawdowns of 2 feet or more per month during the primary spawning months for warmwater game fish (March through July) was reduced by 1 percent during the 70-year simulation period. Therefore, impacts of reservoir drawdown on spawning success of warmwater game fish would be similar to those under the Baseline.

Coldwater Fish Habitat. Under the No-Action Alternative, average monthly reservoir storage would be reduced by 2 to 7 percent in December through March, increased by 2 percent in September and October, and reduced by zero to 1 percent in the remaining months. Reductions in reservoir storage during winter are not expected to cause significant adverse impacts on the reservoir trout fishery because coldwater habitat is unlikely to limit the abundance of stocked trout, especially during the cooler months when the reservoir is thermally mixed. Lower reservoir storage during the winter may actually improve feeding opportunities for rainbow trout by increasing prey availability.

Upper Sacramento River. Under the No-Action Alternative, flow impacts on fishery resources in the upper Sacramento River would be similar to those under the Baseline. No change would occur in the frequency with which flows would meet the October through March minimum release criterion of 3,250 cfs at Keswick Dam.

Downstream from American River. Implementing the No-Action Alternative would have little or no effect on flow and water temperature impacts on fisheries resources in the lower Sacramento River. Changes in average monthly flow at Freeport would be 1 percent or less in all months.

Impacts of Delta outflows and total Banks and Tracy exports on fisheries resources would be similar to those under the Baseline. Changes in average monthly Delta outflow and exports would be 1 percent or less in all months.

Shasta Reservoir. Implementing the No-Action Alternative would have little or no effect on Shasta Reservoir fish habitat and populations. Average monthly reservoir storage differed by less than 1 percent from storage levels under the Baseline.

No change would occur in the frequency with which September storage levels would meet the carryover storage criteria for water temperature control in the upper Sacramento River. Therefore, storage-related water temperature impacts on winter-run salmon spawning success would be similar to impacts under the Baseline.

Clair Engle Reservoir. Implementing the No-Action Alternative would have little or no effect on changes in reservoir storage on reservoir fish habitat or populations. Changes in average reservoir storage would be less than 1 percent in all months.

The frequency of flow reductions of 50 percent or more during the chinook salmon spawning and incubation period would remain unchanged in October through January, increase by 8 percent in November through February, and remain unchanged in December through March. The frequency of 50 percent flow reductions during the steelhead trout spawning and incubation period would increase by 3 percent in January through April and increase by 10 percent in February through May. Therefore, redd stranding impacts were considered significant for steelhead trout and potentially significant for chinook salmon.

Mitigation

There would be no significant impacts on fisheries resources under the No-Action Alternative; consequently, no mitigation is required.

VEGETATION AND WILDLIFE

Baseline

Lower American River. As previously described, the natural processes that support and maintain stands of riparian vegetation and the associated riparian wildlife community were substantially altered in the lower American River by the construction of Folsom and Nimbus Dams. The flow regime and typical annual hydrograph for which the riparian vegetation was adapted has changed such that annual high flows no longer coincide with the time many of the riparian species such as cottonwood and willow shed their seed. In addition, the dams have blocked the transport of much of the upstream sediment. Consequently, deposition of sediment along the banks of the lower American River during high flows, which is necessary for providing an adequate seed bed suitable for the establishment of riparian plants, has been minimized. The elimination of sediment transported from upstream has also resulted in increased erosion and transport of sediment out of the lower American River and incision of the river channel. This condition has led to the migration of the river away from the existing riparian community. Hence, the dams have impaired natural regeneration of the riparian community along the lower American River and the ability of the river to support existing vegetation.

Wetland areas in the river's side channels and isolated ponds have also been affected by changes in the river's flow regime over time. As the river channel continues to meander, wetlands dependent upon recharge from floodwaters and/or ground water supported by streamflow may be eliminated or flooded permanently. Similarly, long-term abundance and distribution of sensitive plant and wildlife species associated with riverine and riparian habitats, as well as the wildlife community as a whole, may change in response to changes in the riparian community.

Significance Criteria. For purposes of this analysis, impacts were considered significant if construction of the project would substantially interfere with the movement of any resident or migratory wildlife species, substantially diminish habitat for wildlife plants, or involve the disposal of material which could pose a hazard to wildlife or plant populations.

Riparian vegetation is adapted to an environment characterized by change (for example, extreme variation in streamflows) rather than stability. Hence, minor variations in the flow regime in this type of environment are not likely discernible. The potential impacts on vegetation and wildlife associated with the No-Action Alternative have been evaluated within this context.

Impacts. The No-Action Alternative would generally result in (1) increased flows during late fall and early winter as flood storage is increased in the reservoir and (2) reduced flows during the spring while the reservoir is refilling. This change in the existing flow regime will not influence, either detrimentally or beneficially, the riparian community's

ability to regenerate. Therefore, the focus of the impact analysis is on maintenance of existing vegetation and wetlands.

Existing riparian vegetation can be affected by changes in flow in several ways:

(1) Reduction in spring flow that prevents recharge of backwater channels and isolated ponds;

(2) Inundation for extended periods during the growing season;

(3) Change in the flow regime such that the frequency of low-flow conditions during the growing season is increased; and

(4) Change in the frequency, duration, and depth of peak floodflows that promote cottonwood and willow regeneration on flood plain terraces.

Based on the requirements of the 1993 Diagram, flows under the No-Action Alternative will differ from those under the Baseline only infrequently ($\leq$12 years) during January and May through December. Additionally, the flow differences during these months were generally minor. In February, March, and April, flows under the No-Action Alternative differed from the Baseline in 43, 33, and 20 of the 70 years evaluated, respectively. Although February showed the highest frequency of flow differences, the magnitude of the flow change would be minor.

An analysis of the frequency of modeled flows (at 500 cfs intervals) during each month over the entire period of record indicated that the frequency of flow levels between 3,000 and 3,500 cfs during March and April is higher under the No-Action Alternative than under the Baseline and lower for flows between 3,500 and 8,500 cfs. There were no differences at flows below 3,000 cfs.

Pond and Backwater Recharge. The riparian vegetation associated with the numerous side channels and isolated ponds along the lower American River is dependent in large part on annual recharge of these areas by high flows in the spring. Reduced spring flows could affect the ability of these areas to recharge. From field studies conducted on the lower American River, Sands (1985) concluded that flows of 2,750 cfs and 4,000 cfs were necessary to recharge the ponds closest to and farthest from the river channel, respectively. The physical solution outlined by Judge Hodge in the *EDF et al. v. EBMUD* decision, which took into consideration the study results of Sands (1985) and others, requires maintaining a flow level of at least 3,000 cfs during the spring to protect lower American River resources, including riparian vegetation and adjacent pond communities. This flow level was used as the threshold criterion for significance.

In dry water years when pond recharge may be reduced, riverflows under the No-Action Alternative would not differ from the Baseline. Specifically, reservoir operations under the 1993 Diagram would not increase the frequency of flows below 3,000 cfs. In

wetter years, flow levels may be reduced, but would not fall below 3,000 cfs during March through June, the growing season for vegetation along the ponds. Accordingly, no significant adverse impacts to riparian vegetation are anticipated as a result of failure to recharge backwater areas under the No-Action Alternative.

Seasonal Inundation. During the primary growing season, March through June, the frequency of inundation of nearshore vegetation would not increase under the No-Action Alternative. In all modeled years, flows were equal to or less than those under the Baseline during March through June. Hence, no adverse impacts on riparian vegetation are expected. During periods of reduced activity (September through January), the No-Action Alternative would result in only minor changes in flow which would not significantly alter the frequency of inundation.

The maximum objective release from Folsom Reservoir will remain at 115,000 cfs. During extreme storms, the overbank areas would be flooded to near the levee tops, as happens under the 1986 operating diagram. When this happens, mobile wildlife species escape to dry areas outside the levees. Nonmobile or hibernating individuals would be killed. This is no change from the Baseline.

Water Availability. Because of past channel incision and the migration of the river channel away from stands of riparian vegetation, extreme low-flow conditions may reduce moisture in the root zone in areas supporting riparian vegetation. As with backwater and pond recharge, the 3,000 cfs flow level contained in the Hodge Decision was intended to provide an adequate level of protection for existing riparian vegetation. Therefore, the 3,000 cfs flow level was used as the criterion for maintaining existing vegetation. Under the No-Action Alternative, flow levels during March through June are identical to the Baseline in dry years when flows are below 3,000 cfs. In the remaining years, flows are always equal to or in excess of 3,000 cfs. Therefore, the No-Action Alternative is not expected to adversely affect riparian vegetation.

Wildlife. The riparian plant community and wetlands along the lower American River will not be significantly affected under the No-Action Alternative. The wildlife community associated with these habitats is not expected to change. With respect to the riparian and open-water species such as piscivorous birds (for example, mergansers, herons, egrets, and kingfishers) which are dependent upon fisheries, a no-impact finding is appropriate based on the determination (discussed above) that the No-Action Alternative would not adversely affect lower American River fisheries.

Lake Natoma. Lake Natoma serves as a regulating afterbay that moderates releases from Folsom Reservoir. Operation of Lake Natoma will not change as a result of the No-Action Alternative, and fluctuations in water-surface elevation would not differ from the Baseline. Therefore, no significant impact is expected on the riparian vegetation, wetlands, and wildlife associated with Lake Natoma.

Folsom Reservoir. As described in the environmental setting, Folsom Reservoir supports a minimal amount of riparian vegetation in the drawdown zone because of the widely fluctuating water-surface elevations resulting from reservoir operation. Typical riparian vegetation does exist where tributary streams enter the reservoir; however, this vegetation is supported primarily by streamflow rather than reservoir level. Because of the recent drought, portions of the drawdown zone have been exposed for a sufficient duration to allow the temporary establishment of some vegetation (primarily willows). These vegetated areas will be lost when reservoir levels rise in response to wetter hydrologic conditions. Accordingly, the No-Action Alternative would not affect riparian vegetation at Folsom Reservoir.

Wetlands do not exist within the drawdown zone, although in 1992 the FWS identified established backwater marsh areas in the reservoir that are normally inundated but may become dewatered under reoperation. These areas, which exist primarily near the upper arms, provide habitat for migrating waterfowl during winter. In wet years, these backwater marsh areas may not be inundated due to an increased drawdown. However, the frequency of dewatering of these areas would not substantially increase under the No-Action Alternative. Therefore, there would be no significant impact to this vegetation or to waterfowl using these habitats.

Mitigation

No significant impacts were identified for the No-Action Alternative; consequently, no mitigation is required.

ENDANGERED SPECIES

Baseline

A complete discussion of listed species which may be affected by the No-Action Alternative may be found in chapter 4. Table 4-2 lists sensitive plant and wildlife species, their scientific names, and their status.

Significance Criteria

For the purposes of this analysis, any action undertaken directly in connection with, or indirectly caused by, the project which may affect the continued existence of a threatened or endangered species is considered a significant adverse impact.

Impacts

Lower American River. The sensitive species described in chapter 4 for the lower American River are the same as would be affected under this alternative.

Folsom Reservoir. The sensitive species described for the lower American River, with the exception of the bald eagle, either do not occur in or near the reservoir or will not be affected by permanent reoperation.

Bald eagle. Bald eagles are known to use Folsom Reservoir during winter. Impacts resulting from the No-Action Alternative could be expected if the project caused a substantial reduction in the warm and/or cold water fishery in Folsom Reservoir. The No-Action Alternative would not result in a substantial reduction in the Folsom Reservoir fishery. Therefore, a reduction in the bald eagle prey base is not expected. Although habitat suitability at Folsom reservoir may be decreased, a significant impact on bald eagles is not expected for two reasons. First, the number of eagles and the extent to which the area is used is very low. Second, wintering bald eagles are extremely mobile and have the ability to exploit food sources over a wide geographic range. Thus, it is doubtful that the potential reduction in habitat suitability at Folsom Reservoir would inhibit the ability of wintering bald eagles to obtain food.

Shasta Reservoir. The No-Action Alternative could alter water-surface elevations and storage levels in Shasta Reservoir. Changes in water-surface elevations would affect nearshore habitats and the distance between upland habitats and the water's edge. Nearshore areas of Shasta Reservoir support little vegetation and, consequently, are of limited value to wildlife. Changes in the distance between upland habitats and the water's edge, however, could affect bald eagle foraging at the reservoir.

Bald eagle. In most years, water-surface elevations would not differ between the No-Action Alternative and the Baseline. In the few years that water-surface elevations would be reduced, the reductions would be minor. The maximum reduction in water-surface elevation was 7.5 feet. However, reductions in water-surface elevations were less than 3 feet in most years when reductions occurred. In only 5 months of the entire period of record were water-surface elevations reduced by more than 5 feet. These minor and infrequent reductions in water-surface elevations would not result in a significant impact to bald eagle foraging.

Clair Engle Reservoir.

Bald eagle. As with Shasta Reservoir, potential impacts to wildlife at Clair Engle Reservoir would be limited to potential adverse effects on bald eagle foraging success. Bald eagles nest and overwinter at Clair Engle Reservoir, and, therefore, could be affected by reduced water-surface elevations throughout the year. In most years, water-surface elevations in Clair Engle Reservoir would not differ between the No-Action Alterative and the Baseline. In the few years that reoperation would reduce water-surface elevations, the reductions would be minor, less than 3 feet. The minor and infrequent reductions in water-surface elevations would not result in a significant impact to bald eagle foraging.

Mitigation

Because the impact to endangered species would be infrequent and insignificant, no mitigation would be required.

CULTURAL RESOURCES

Baseline

Lower American River. In the lower American River area, 42 archeological sites, 7 historic properties, and 3 potentially historic railroad bridges have been identified. Because the entire area has not been systematically inventoried, many more previously unidentified sites are certain to exist there. Four properties are listed in or eligible to be listed in the NRHP (National Register of Historic Places), and few of the remaining properties have been evaluated for NRHP eligibility. Under the 400,000 acre-foot condition, these properties, particularly the archeological sites, are subject to numerous adverse impacts, many of which are severe, including alluvial erosion and vandalism. In addition, flooding in excess of the current level of protection could cause significant damage to a number of the prehistoric and historic archeological sites along the terraces of the lower American River. Similarly, emergency discharges in excess of the current objective release of 115,000 cfs could result in significant damage to sites.

Folsom Reservoir. Several surveys and studies have been conducted since the construction of the dam. At least 123 prehistoric sites and approximately 52 historic era properties have been recorded. Primary archival and secondary sources suggest that more than 200 other potential sites or features may exist in the reservoir (Peak and Associates, 1990). Because the entire area has not been systematically inventoried, many more previously unidentified properties may be present. The Folsom Powerhouse is the sole property at the reservoir which is listed or eligible to be listed on the NRHP. Under the 400,000 acre-foot condition, these sites are subject to numerous adverse impacts, many of which are severe, including erosion caused by wave action, vandalism, alternate drying and inundation, and damage by offroad vehicles.

Upper American River. Previous studies have documented 1,589 historic and 125 prehistoric archeological sites in the Auburn area. Included among the cultural properties in this area are numerous manmade structures which must be evaluated for NRHP eligibility. Under the 400,000 acre-foot condition, these resources are subject to the effects of pluvial, eolian, and, to a lesser extent, alluvial erosion. In addition, they are under moderate to severe pressure from vandalism and recreational activities.

Downstream from American River. Two prehistoric archeological sites and a single historic period archeological site exist within the area downstream from the American River. In addition, numerous historic period structures exist there, including the Sacramento Weir, which is eligible for listing in the NRHP, and other unevaluated properties. No notable

adverse impacts are known to be occurring with respect to these cultural properties under the current operating regime.

Significance Criteria

For the purposes of the this analysis, impacts to cultural resources are considered significant if the affected property is a site, building, structure, or object which is recognized as culturally or historically significant based on institutional, public, or technical criteria which are explained in detail in chapter 4.

Impacts

Lower American River. The vast majority of sites along the lower American River corridor are currently undergoing severe erosion associated with both natural processes, such as root and rodent intrusion, as well as man-induced effects such as fluctuating river levels. Increased population, land use, and related urban growth along the river corridor would continue generally as described in current local plans. Vandalism has been noted at several sites and is expected to continue. Similarly, the recreational opportunities afforded by the American River Parkway introduce additional elements of looting and collecting. Thus, the above-listed factors will continue to subject historic properties to adverse impacts under current conditions (the No-Action Alternative).

Folsom Reservoir. Changes in water-surface elevations in Folsom Reservoir under the current operating regime have severely damaged most of the cultural sites within the inundation zone of the reservoir (Waechter and Mikesell, 1994). This condition would continue under the No-Action Alternative.

Based on information from the California Historical Resources Information Center, 143 known sites in the Folsom Reservoir inundation zone could be affected under without-project conditions. Additional sites that have not been identified in previous surveys also may exist. Of the 143 known sites, 35 are located within 0.25 mile of designated recreation areas and are therefore subject to a higher degree of disturbance than those farther away.

Under the 400,000 acre-foot condition, all the 143 known sites and any unidentified sites would continue to be subjected to effects caused by wave action, vandalism, alternating drying and inundation, and inadvertent damage by offroad vehicles.

The same number of sites would be exposed to various potential impacts under both the 400,000 acre-foot condition and the No-Action Alternative. The only difference between the 400,000 acre-foot condition and the No-Action Alternative is the degree of impact. However, a review of the hydrologic modeling for the 400,000 acre-foot condition and the No-Action Alternative indicates that the differences in the level of impacts would be minor. In general, sites at higher elevations would be exposed to the greatest levels of impact, both from wave action and from human actions.

One known site in the Folsom Reservoir inundation zone would not be affected by exposure-related impacts. The remaining 142 sites would continue to be affected by wave action and exposure similar to the effects described under the 400,000 acre-foot condition. An unknown number of additional cultural resource sites that have not been identified also could be similarly affected. Implementing either of the alternatives would contribute slightly to the ongoing significant effects on cultural resources. This contribution to ongoing effects is considered significant.

Downstream from American River. No adverse impacts are anticipated to historic properties in the Sacramento River area.

Shasta Reservoir. Changes in water-surface elevations in Shasta Reservoir under the No-Action Alternative would be less than those experienced in Folsom Reservoir. In about 85 percent of the 840 months of the period of record, water-surface elevations would differ from the 400,000 acre-foot Condition by less than 1 foot (appendix G). In about 10.5 percent of the months, water-surface elevations would be 1 to 3 feet lower, and in the remaining 4.5 percent of the months, water-surface elevations under the No-Action Alternative would be 3 to 8 feet lower. Due to the low magnitude and infrequent occurrences of differences in water-surface elevations between the No-Action Alternative and the 400,000 acre-foot condition, sites of historical or cultural significance along the shoreline of Shasta Reservoir would not be subjected to a substantial increase in exposure or wave action. Therefore, no significant impacts to cultural resources at Shasta Reservoir would occur under the No-Action Alternative.

Clair Engle Reservoir. Changes in water-surface elevations in Clair Engle Reservoir under the No-Action Alternative relative to the 400,000 acre-foot condition would be minor and infrequent. In about 96.4 percent of the 840 months of the period of record, water-surface elevations would differ from the 400,000 acre-foot condition by less than 1 foot (appendix G). In the remaining 3.6 percent of the months, water-surface elevations under the No-Action Alternative would be 1 to 3 feet lower. Due to the low magnitude and infrequent occurrences of differences in water-surface elevations, sites of historical or cultural significance along the shoreline of Clair Engle Reservoir would not be subjected to a substantial increase in exposure or wave action. Therefore, there would be no significant impacts to cultural resources at Clair Engle Reservoir.

Mitigation

Compliance with the National Historic Preservation Act would reduce the potentially significant impacts on Folsom Reservoir sites likely under the No-Action Alternative to a less than significant level. The SHPO has recommended that a Research Design be prepared to serve as a foundation for determinations of eligibility for inclusion of Folsom Reservoir sites into the NRHP. The research design would also serve to identify additional areas for inventory. Future actions to achieve compliance with the National Historic Preservation Act call for preparing an agreement document; field work to aid in the determinations of

eligibility process; developing a Findings of Effects document; and preparing a treatment plan for select resources and select treatment, including stabilization of appropriate sites.

WATER QUALITY

Baseline

Water quality along the lower American River is generally good to excellent for all beneficial uses. However, dissolved oxygen and temperature do not meet some beneficial objectives during low-water years when flows in the river are reduced. Runoff from the portions of the lower American River area north of the river is collected and discharged into the American River. Runoff from areas south of the river is collected and discharged into the Sacramento River.

Significance Criteria

For purposes of this analysis, any degradation in water quality below relevant standards established by the SWRCB or EPA would constitute a significant impact. For this analysis, January 1994 EPA Standards, D1485 Standards, and the December 1994 Bay-Delta Standards were used as parameters to determine adverse effects to water quality in the lower American River and the Delta. (See chapter 4, Water Quality, and Montgomery Watson, 1996.)

Impacts

American River Basin. Water-quality problems, including low dissolved oxygen concentrations and microorganism blooms that contribute to taste and odor problems in domestic water supplies, are largely attributable to elevated water temperatures. In Folsom Reservoir, these problems occur during the summer when storage falls below about 400,000 acre-feet and water temperatures exceed about 70 °F. The No-Action Alternative would not significantly increase the frequency at which these conditions would be expected.

Water quality in the lower American River is also affected by elevated water temperatures. However, for the reasons discussed above, the No-Action Alternative would not significantly increase the potential for conditions detrimental to water quality in the lower American River.

Sacramento River Basin/Delta. Reclamation is required under the 1994 Bay Delta Standards to maintain water quality standards in the Delta. Compliance with the conditions in the 1994 Bay Delta Standards was an inherent assumption in the hydrologic modeling performed in connection with this final SEIS/EIR.

Mitigation

There are no significant impacts on water quality in Folsom Reservoir on the lower American River under the No-Action Alternative; consequently, no mitigation is required.

VISUAL RESOURCES

Baseline

Lower American River. The lower American River provides a variety of visual experiences, which include steep bluffs, terraces, islands, backwater areas, and riparian vegetation. The natural environment is a refreshing contrast to the urban development of the surrounding Sacramento area.

Folsom Reservoir. Folsom Reservoir visual resources have been demonstrably negative in their natural appearance for much of the last decade, to the extent that the existing "bathtub ring" of exposed shoreline is an unappealing, and therefore negative, viewscape.

Upper American River. There would be no adverse effects to visual resources in the upper American River area.

Downstream from American River. The visual resource values of the Sacramento River system are varied and represent a complex setting of geomorphic landscapes, vegetative communities, and open and confined waterways.

Shasta and Clair Engle Reservoirs. Both Shasta and Clair Engle Reservoirs are conserved under the National Recreation Area objectives which protect lands of recreational and scenic value (U.S. Department of Agriculture, 1987). Although human-made, these reservoirs have been established for many years and when full appear essentially natural. They are both surrounded by coniferous forest. Typically, though, the reservoirs have not been full due to drought. The visual quality of the reservoirs is degraded during low water years, because the drawdown zone detracts from the scenery. Shasta Reservoir can be viewed by passers-by on Interstate 5; therefore, it is exposed to significantly more viewers than is Clair Engle Reservoir.

Significance Criteria

Evaluation of visual quality often results in a subjective discussion that reflects the values and priorities of those performing the analysis. Several criteria are used to evaluate visual impacts, including the qualities of vividness, intactness, and unity. Definitions for the criteria include the following:

- "Vividness" is the visual power or memorability of landscape components as they combine in striking and distinctive visual patterns.

- "Intactness" is the visual integrity of the natural and manmade landscape and its freedom from encroaching elements. This factor can be present in urban and rural landscapes and natural settings.

- "Unity" is the visual coherence and compositional harmony of the landscape considered as a whole. It frequently attests to the careful design of individual components in the manmade landscape.

If, based on these criteria, the project would (1) induce a substantial, demonstrable negative visual effect; (2) result in the creation of a visually offensive site open to public view; (3) significantly change the existing visual quality of the region; or (4) eliminate visual resources, it would be identified as having a significant impact. Reduction in water-surface elevation of 10 feet or more is discernible to most of the general public, and a reduction of 15 feet or more is demonstrably negative and would be considered significant.

Impacts

Folsom Reservoir. Under the Baseline, visual resource values of Folsom Reservoir and the State Recreation Area would remain subject to the same natural and operational regimes to which they are now subject. Visual resource impacts would not exceed that range normally expected. The visual resource impacts of permanent reoperation should, therefore, be considered, since the reservoir has been visually impaired for some time.

Summer Season Impacts. Under the No-Action Alternative, reservoir water-surface elevations would only be reduced in 6 months of the summer recreation period of record (350 months [April-August for 70 years]) by an amount ranging from 2.4 to 6.1 feet. This low frequency of occurrence (1.4 percent) and low magnitude (up to 6.1 feet) of reduced elevations does not represent a significant adverse effect to visual resources.

Winter Season Impacts. In the winter recreation season (September-March), reservoir surface elevations would be reduced in 41 months of the corresponding 490-month period of record, or about 8 percent of the winter months.

- In 24 of these 41 months, or about 4.9 percent of the total months in the winter recreation season, discernible reservoir water-surface elevation reductions of 10 or more feet would result.

- In 19 of these 41 months, or about 3.9 percent of the total months in the winter recreation season, demonstrably negative reservoir water-surface elevation reductions of 20 or more feet would occur under this alternative.

- In 15 of these 41 months, or about 3.1 percent of the total months in the winter recreation season, definitively negative water-surface elevation reductions of 30 or more feet would occur under this alternative.

Based on the modeled output for the 70-year period of record, the duration of elevation reductions of 10 or more feet could have extended for one 8-month period in water year 1984, two 5-month periods in water years 1951 and 1970, and one 4-month period in water year 1965. These periods equate to 22 of the 41 winter months in which such differences could have occurred. The remaining 19 months occurred in periods of three or less consecutive months.

The data reflecting the potential duration of visual resource impacts under the No-Action Alternative, therefore, support a very small probability (1 in 70, or 1.4 percent) that such elevation reductions would persist for longer than 8 months. There would only be a 2.8 percent probability that such elevation reductions would persist for more than 5 months.

Impacts to visual resources would, therefore, be short-lived. Although the No-Action Alternative would induce, at times, substantial demonstrable negative visual effects, those effects would be temporary and would disappear as the reservoir refills to levels that would have occurred in the absence of the project (probably in about 3 months or less). As a result, the No-Action Alternative would not result in the creation of a visually offensive site and would not permanently change the visual quality of the region, or permanently eliminate visual resources since the reservoir retains the capability to refill. Visual resource impacts are, therefore, found not to be significant.

Shasta Reservoir. Under the No-Action Alternative, visual resource values of Shasta Reservoir would remain subject to the same natural and operational regimes to which they are now subject. There would be no additional impacts to visual resource values.

Summer Season Impacts. The No-Action Alternative could negatively affect visual resource values of Shasta Reservoir if water-surface elevations in the reservoir were substantially lowered or the frequency or duration of low water-surface elevations substantially increased.

In most years, water-surface elevations during April through August would not differ between the No-Action Alternative and the Baseline. Water-surface elevations would be reduced by more than 1 foot in 32 months of the 350-month summer recreation period of record, with a maximum reduction of 7.3 feet. In all but 3 months during the summer period of record, water-surface elevations would change by less than 5 feet. Water-surface elevations were reduced by greater than 5 feet during June, July, and August of a single year, 1970. In no years would water-surface elevations be reduced by 10 feet or more. The infrequency and low magnitude of potential reductions in water-surface elevations in Shasta Reservoir during April through August does not constitute a significant adverse impact to visual resource values.

Winter Season Impacts. Water-surface elevations were reduced more frequently during the winter (September through March) than during the summer. However, as with the summer season, water-surface elevations under the No-Action Alternative would not differ from the Baseline in most years. Reductions in water-surface elevations of greater than 1 foot would occur in 64 months of the 490-month period of record for the winter season. In one winter season (September 1970 through November 1971), however, water-surface elevations were reduced by greater than 5 feet, but in no years were reductions in water-surface elevation greater than 10 feet.

Clair Engle Reservoir. Under the No-Action Condition, visual resource values of Clair Engle Reservoir would remain subject to the same natural and operational regimes to which they have been subject under the Baseline.

Summer Season Impacts. In most years, water-surface elevations in Clair Engle Reservoir during the summer season (April through August) would not differ between the No-Action Alternative and the Baseline. In only 9 months out of 350 months of the 70-year period of record for summer months would water-surface elevations be reduced by greater than 1 foot. In August 1985, the maximum reduction was 2.5 feet.

Winter Season Impacts. In most years, water-surface elevations in Clair Engle Reservoir during September through March would not differ between the No-Action Alternative and the Baseline. In only 20 months out of 490 months of the 70-year period of record for the winter season would water-surface elevations be reduced by greater than 1 foot. In October 1986, the maximum reduction was 2.9 feet.

Mitigation

Continued reoperation would not have significant impacts to visual resources at Folsom Reservoir; therefore, no mitigation is required.

COMPARISON OF FOLSOM MODIFICATION PLAN TO BASELINE

Reoperation of Folsom Reservoir using the 475,000 to 720,000 acre-foot flexible storage diagram would not result in significant impacts to most of the resources listed above when compared to the No-Action Alternative. When compared to the baseline condition, the resources listed below would have greater adverse impacts. The impacts and mitigation are discussed below.

WATER SUPPLY

CVP/SWP Deliveries

Impacts. Reoperation to 475,000/720,000 would reduce water supplies systemwide by about 19,000 acre-feet a year.

Mitigation. Mitigation for the reduction in water supply would be similar to that for the No-Action Alternative; that is, reduce demand on reservoirs when reoperation reduces supplies. This program would cost about $9.1 million a year.

Local Water Supply

Impact. Reoperation would occasionally lower Folsom Reservoir water surface, requiring more pump energy. In rare years, such as 1976 and 1977, local supply could be reduced by up to 20 percent (if not mitigated).

Mitigation. Local pumping agencies would be reimbursed for the anticipated additional energy needed for pumping. Pump modifications could be made to increase efficiency as well. The cost for the pump energy is estimated at $40,000 per year. Reduced water supply in unusual years would be mitigated by the CVP water replacement mitigation plan. Folsom Reservoir levels would be restored to prereoperation levels by the end of the water year by reducing water demands. This should preclude local water supply reductions from reoperation.

Hydropower

Impacts. Reoperation would reduce hydropower production.

Mitigation. Mitigation for the reduction in hydropower would be similar to that for the No-Action Alternative, reimbursement to WAPA. The cost would be about $2.5 million a year.

RECREATION

Impacts. Reoperation under this plan would cause potentially significant impacts to off-season recreation at Folsom Reservoir as a result of low availability of boat launching facilities.

Mitigation. This impact could be mitigated to a less than significant level by modifying or extending low-water boat ramps at Granite Bay, Hobie Cove, Brown's Ravine Marina, and Dike 8.

FISHERIES AND AQUATIC RESOURCES

Impacts

Reoperation under the Folsom Modification Plan would potentially cause significant redd stranding impacts on chinook salmon and steelhead in the lower American River. In addition, the Folsom Modification Plan could result in the significant cumulative impact of increasing the frequency-of-flow reductions during chinook salmon and steelhead trout spawning and incubation periods.

Mitigation

Redd stranding impacts can be reduced by decreasing the rate at which flows are reduced during the chinook salmon and steelhead trout spawning and incubation periods. The impacts to the frequency-of-flow reductions may not be mitigable considering the inflexibility of seasonal flood control criteria under the Folsom Modification Plan.

CUMULATIVE IMPACT SUMMARY

This cumulative impact summary uses the Council on Environmental Quality's definition of a "cumulative impact" as the environmental impact resulting from the incremental impact of a proposed action, when added to other past, present, and reasonably foreseeable future actions, both Federal and non-Federal.

The American River Watershed Project report examines three major alternative courses of action, each having several individual components, which could be implemented to improve flood protection for the greater Sacramento metropolitan area, which is in the American River flood plain. Many other alternative flood control actions or component activities with potential to contribute to solving the problem were found infeasible or not cost effective. The No-Action Alternative is also discussed and represents the most likely "default" course of action in the event that none of the action alternatives becomes authorized.

Comprehensive evaluation of the cumulative impacts of each alternative is difficult because of their complexity and the large diversity of potential ramifications. To keep the discussion of cumulative impacts of this project pertinent, it was necessary to limit evaluations to related or similar projects in the local region.

The Folsom Modification and Stepped Release Plans would not significantly increase the cumulative effects on CVP and SWP operations identified in connection with the No-Action Alternative. Other cumulative impacts of major concern are related to the potential losses of riparian and wetland resources throughout the local region due to other flood

control projects that are planned or under way to repair and upgrade the Sacramento River Flood Control Project or address other local or regional flooding problems.

Cumulatively, the other various flood control projects will have the beneficial effect of raising the level of flood protection provided to lands in the local Sacramento Valley region, thereby reducing the risk of adverse impacts related to flooding. At the same time, however, these projects could reduce the small remaining wetland and riparian ecosystems along the rivers and streams where construction would take place. These impacts are generally mitigated, resulting in no net loss of riparian and wetland values, but causing temporary losses and probable changes in the specific types, quantities, and locations of these habitats.

The potential regional cumulative impacts of the various alternatives were portrayed by describing the current status of other projects along the Sacramento River and its tributaries and bypasses in the nearby region which could produce construction impacts similar to those of the Folsom Modification and Stepped Release Plans along the lower American River. Following is a summary of the main ways that each alternative will potentially result in cumulative impacts in association with similar or related projects that are ongoing or planned in the local regional area.

NO-ACTION ALTERNATIVE

Cumulative impacts would occur with the No-Action Alternative if it is assumed that reoperation of Folsom Reservoir becomes permanent according to the 1993 Diagram. These impacts include minor regional changes due to decreases of stored water and production of hydropower at Folsom that are linked to larger projects such as the Central Valley Project and State Water Project. In addition, there would be relatively greater cumulative impacts to local resources such as water supply and water-oriented recreation at Folsom Lake.

Other local resources at Folsom Lake and downstream in the lower American River, such as fisheries, riparian vegetation and wildlife, water quality, and cultural and visual resources, would be affected somewhat by implementation of permanent reoperation. However, average annual impacts are projected to be minor overall; over the long term, they will be within a few percent of existing production levels. Production of some local resources that are dependent on seasonal availability of water would be less, but this is also true in the baseline situation, as evidenced during the 1987-92 drought.

The cumulative impacts of concern under the No-Action Alternative are those associated with CVP/SWP operations. The model studies conducted in connection with this alternative incorporate anticipated future actions which could affect reasonably foreseeable demand for increased consumptive water use based on projections through the year 2020 and for environmental purposes based on changes in Delta water quality and flow standards. When compared to the systemwide demands for CVP/SWP water, the impacts of permanent reoperation are considered to be very small. However, the studies do not account for CVPIA (Central Valley Project Improvement Act) because of the uncertainties associated

with the timing and manner of implementation, nor do they address the impacts on CVP storage of increased upstream diversions combined with higher instream flow requirements in the lower American River. In this regard, Folsom reoperation does reduce CVP carryover storage and lessen Reclamation's flexibility to respond to demands placed on the overall system.

On a regional basis, it appears that in the near term the cumulative impacts of losses of most local resources at Folsom Lake associated with the No-Action Alternative will be insignificant because there is enough flexibility available in operations of linked facilities to compensate for shortfalls. The greatest concern is with regard to projected future deficiencies of water, hydropower, etc., over a long-term planning horizon greater than 25 years. In the meantime, it appears that, cumulatively, minor losses of production of these resources is a worthwhile tradeoff for increasing the level of flood protection to at least 100 years for the American River flood plain.

FOLSOM MODIFICATION PLAN

Potential cumulative adverse impacts of the Folsom Modification Plan are greater than the No-Action Alternative because the plan includes constructing improvements to Folsom Dam, the lower American River levees, and the east levee of the Sacramento River protecting the Natomas area, as well as an increased level of Folsom reoperation for flood management. Regionally, the extent of riparian and wetlands habitats cumulatively affected by construction of flood control projects in the foreseeable future is potentially greater than for the No-Action Alternative, although these projects will be largely or completely offset by mitigation over the long term.

As with the No-Action Alternative, local resources produced at Folsom Lake that would probably be significantly affected by reoperations include water supply, hydropower, cultural resources, and recreation. There will be more years when the requirement to maintain lower water levels will result in less Folsom Lake recreation, water supply, and power production. Regionally, cumulative impacts to these resources may be considerable in some years, but probably would not be of sufficient magnitude to be called significant overall, because of the availability of alternative recreation opportunities and water and power supplies from other lakes that are either privately owned or part of the CVP and SWP systems.

Locally significant adverse cumulative impacts of increased reoperations associated with the Folsom Modification Plan include effects to Folsom Lake recreation and to downstream fisheries and aquatic resources. These effects are primarily associated with the potential for decreased seasonal boat access to the lake and for the possible stranding of salmon and steelhead redds below Nimbus Dam in some years. It is thought that boat ramp extensions could mitigate Folsom Lake recreation impacts to less than significance, but it may not be possible to mitigate for redd stranding in some years because the increased fall

drawdown required would deplete the available supply of water of suitable temperatures in the late fall-early winter season.

The Folsom Modification Plan would not increase the cumulative effects on overall CVP operations identified in connection with the No-Action Alternative. Accordingly, for purposes of this analysis, cumulative impacts were assessed by listing the projects which could produce impacts similar to the construction impacts produced by the Folsom Modification Plan along the lower American and Sacramento Rivers and their tributaries. The impacts of concern are those related to the loss of riparian and wetland resources over time.

STEPPED RELEASE PLAN

Potential cumulative adverse impacts of constructing facilities necessary for the Stepped Release Plan are locally and regionally even more significant than for the Folsom Modification Plan because more areas will be built on and a higher floodway design capacity is specified. However, detailed projections of impacts to resources such as fish and wildlife habitat and recreation show that mitigation measures could be implemented which would largely or completely offset potential losses.

It appears likely that construction and mitigation proposed for the Stepped Release Plan, when evaluated locally and regionally over the long term, will result in minor net cumulative impacts for most resources. Resources such as fish and wildlife habitat will be affected somewhat during construction, but should recover to comparable levels regionally over the long term as a result of mitigation measures. Improved and new outdoor recreation facilities in the lower American River floodway will result in beneficial cumulative impacts regionally and over time.

Cumulative adverse impacts associated with long-term operations of the Stepped Release Plan would be minor for resources of concern. Proposed Folsom Lake reoperations would be the same as discussed previously for the No-Action Alternative. During unusual flood events, it will be necessary to increase the amount of the objective releases into the lower American River. However, the various levees and riverbanks would be rebuilt to handle greater floodflows, resulting in some loss of riparian habitat. Recreation facilities and roads would be temporarily affected during construction. Utilities would not be affected. On average, as with the No-Action Alternative, cumulative losses of recreation, water, and power production at Folsom Lake can be compensated by integrating reoperations with existing regional production.

DETENTION DAM PLAN

The periodic inundation within the upper American River has potential to cause vegetation mortality, soil losses, and physical damage to roads, trails, and other recreational

facilities. Planting 2,774 acres of the same species offsite at a location along the Yuba River would reduce this vegetation loss from construction and operation to insignificance. Also, under the adaptive management plan, an additional 1,481 acres of vegetation similar to that lost would be planted in the inundation zone. The vegetative planting also mitigates for wildlife habitat losses. This would cause losses of wildlife and fisheries habitat values and recreational capabilities and the visual resource quality for existing uses such as whitewater rafting, hiking, and nature appreciation. However, the conditions of inundation are projected to ameliorate impacts to these resources; that is, because inundation would be of fairly short duration (less than 28 days for all areas) and would occur during the winter dormant season when plants are least likely to be affected.

Regionally, considering the number of major dams and reservoirs that have been built on similar rivers on the western slope of the Sierra Nevada at this elevation, there are potentially significant cumulative impacts associated with building another dam. Because the proposed dam would be operated for temporary flood detention rather than permanent water impoundment, as described above and in chapter 9, it is not thought that this kind of dam operation will affect vegetation, various recreational uses, or other resource values nearly as much as operation of a permanent reservoir.

Construction of the flood detention dam as proposed under the Detention Dam Plan would require relocating Highway 49. The impacts of this relocation along any one of the four alignments currently being contemplated will be evaluated on a programmatic basis to determine whether these impacts would be cumulatively significant when added to the impacts resulting from constructing the flood detention dam.

The following analysis identifies and describes the projects being undertaken to repair and upgrade the Sacramento River Flood Control Project and address local flooding problems. Cumulatively, these projects would have the beneficial effect of raising the level of flood protection provided to lands in the Sacramento Valley, thereby reducing the risk of adverse impacts related to flooding. At the same time, however, these projects could reduce the small remaining wetland and riparian ecosystems found along the rivers and streams where construction would take place. These impacts are generally mitigated, resulting in no net loss of riparian and wetland values, but resulting in changes in the specific types, quantities, and locations of these habitats.

SACRAMENTO RIVER FLOOD CONTROL PROJECT

The Central Valley of California is 450 miles long and 40 miles wide and drains approximately 57,000 square miles. The Sacramento Valley occupies the northern half of this drainage and drains approximately 27,000 square miles of basin. Before valley lands were reclaimed for agricultural development, a large part of the Sacramento Valley, including the Delta lands south of Sacramento and the basin lands between the river and the uplands, were subject to annual or periodic overflow. The potential flood plain, irregular in

outline, varied in width from about 2 to 30 miles, extended 250 miles from Red Bluff to the mouth of the Sacramento River, and comprised an area of over 1 million acres.

The flood control system along the Sacramento River and its tributaries has evolved since the mid-1800's when levees were first constructed to control seasonal flooding. As described in chapter 4, the present system consists of the network of dams, levees, weirs, and bypasses which collectively comprise the Sacramento River Flood Control Project.

Although riparian vegetation was directly affected by the construction of the project, losses of this habitat were largely unmitigated because at that time there were no provisions in the project authorizations requiring either an environmental impact analysis or mitigation. Also, riparian vegetation was indirectly affected due to an increase in private development as a result of increased flood control. These impacts were also unmitigated. However, positive socioeconomic benefits have accrued due to greatly reduced flood damages.

Various studies of the historical and present extent of riparian vegetation along the Sacramento River and tributaries agree that less than 2 to 3 percent of historical woody riparian habitat area remains. It is assumed that cumulative effects on wildlife, fisheries, and plant species dependent on riparian habitats (terrestrial and aquatic) are directly correlated with the reductions in natural riverbank and riparian vegetation. Given the importance and value of this vegetation to wildlife and fisheries and the reduction to date, any further reduction must be considered a significant adverse impact.

As a result of the 1986 flood, various problems, including levee instability and lack of system capacity, were identified within this integrated flood control system. Accordingly, the Corps has initiated various investigations to identify and address these problems. These studies are listed below and their interrelationships are described.

SACRAMENTO RIVER FLOOD CONTROL SYSTEM EVALUATION

This study has reexamined the integrity of the Sacramento River Flood Control Project based on the events of the 1986 flood. The system includes 980 miles of levees and is designed to provide varying degrees of flood protection to lands adjacent to the Sacramento River from Chico Landing near Red Bluff south to Collinsville in the Sacramento-San Joaquin Delta, and the lower reaches of several tributaries including the American River. The study will determine if the system is functioning as designed or if remedial work is required to restore levees to their previously established design and functions. Many of the project levees were built in the late 1800's and early 1900's by landowners and local reclamation districts. These levees were later improved and incorporated into the Sacramento River Flood Control Project by 1960. Because of the size and complexity of this system, the reevaluation was conducted in five phases.

Phase 1 consists of the Sacramento Urban Area Levee Reconstruction Project, which was designed to stabilize the east and west levees of the Sacramento River protecting

Natomas, the Greenhaven-Pocket area of the City of Sacramento, and the City of West Sacramento. These levees were too porous in some areas to meet design specifications. This problem has been corrected by inserting a bentonite and soil seepage wall to form an impervious core in the east levee between Freeport and the I-5 crossing and the west levee below the Sacramento-American River confluence. The east levee above the I-5 crossing has been stabilized through the placement of a new berm along the landside toe of the levee. Construction began in August 1990 and was completed in June 1993.

The levees have been strengthened but not raised beyond their original design elevation; therefore, no indirect impacts due to increased development were incurred. Construction took take place on the landward side of the levees, thereby minimizing environmental impacts. However, 70 acres of upland/riparian vegetation and 44 acres of open water/emergent marsh were removed or covered by construction. These losses were fully mitigated by acquiring and developing a 114-acre mitigation site south of I-5 and west of the river, creating a small lake, and planting the area with native wetland and riparian species (including elderberry shrubs). Details on the environmental analysis can be found in the Finding of No Significant Impact/Negative Declaration for the "Sacramento Urban Area Levee Reconstruction Project, Sacramento, California," completed in July 1990.

Phase 2 focuses on the levee systems along the Feather and Yuba Rivers in the Cities of Marysville and Yuba City. The initial appraisal report for this phase identified work consisting of raising 10.7 miles of levees to their authorized height and providing 19.5 miles of toe drains for levee stabilization. This project is currently being constructed.

Phase 3 focuses on the mid-valley area between Sacramento, Marysville-Yuba City, and the Yolo Bypass from Fremont Weir to south of Putah Creek. The initial appraisal of the levees was completed in 1990. Recommended work includes 22.3 miles of levee raising, 4.9 miles of stabilizing berms, and 9.1 miles of seepage wall.

Phase 4 focuses on the levees in the Delta from Sacramento through Collinsville. Phase 5 concentrates on the levees of the upper Sacramento River north to Chico Landing. Initial appraisal reports for phases 4 and 5 have been completed.

The improvements identified in phases 2 through 5 may result in unavoidable losses of wildlife habitat. Mitigation for this construction-related impact will likely consist of management of project lands to compensate for the lost habitat values. A programmatic EIS for the "Sacramento River Flood Control System Evaluation, Phases II-V" was completed in December 1991. Further environmental documentation will be completed for each phase as plans are finalized and after systemwide economic analyses are completed.

WEST SACRAMENTO PROJECT

This study examines ways to increase flood protection for portions of Southport and the City of West Sacramento. The study includes developed areas along the Sacramento

River and Yolo Bypass from the Fremont Weir downstream to an area just south of Freeport. The draft feasibility study was completed in September 1991. The project calls for raising the south levee of the Sacramento Bypass and the east levee of the Yolo Bypass below the Sacramento Bypass. This project would provide more than 400-year protection to the City of West Sacramento.

A total of 38 acres will be directly affected: 11 acres of wetlands and 27 acres of uplands. These acres would be fully mitigated through the acquisition and development of a 52.5-acre mitigation site. The tentatively selected mitigation site is adjacent to the Sacramento River Deep Water Ship Channel, south of the project area. Details of the impact analysis and mitigation plan can be found in the Feasibility Report and Environmental Impact Statement/Report for the Sacramento Metropolitan A: , California, which was made available in February 1992.

CACHE CREEK SETTLING BASIN RECONSTRUCTION PROJECT

This project raised the settling basin levees and weir to again trap the large volume of sediment flowing down Cache Creek before the creek enters the Yolo Bypass. By retaining the sediment in the settling basin, the capacity and effectiveness of the Yolo Bypass to provide flood protection are maintained. Construction began in late 1990 and has been completed. Coordination with interested agencies has confirmed that no adverse environmental impacts were included; therefore, no mitigation plan was developed.

SACRAMENTO RIVER BANK PROTECTION PROJECT

This project is a long-term program that allows the Corps to use erosion control and setback levees to maintain the integrity of the Sacramento River Flood Control Project. Erosion control includes various forms of bank protection, but primarily consists of placing rock riprap to protect the levees. Setback levees involve moving existing levees farther from the river. The project area encompasses the 980 miles of levees along the east and west banks of the Sacramento River from Collinsville to Chico Landing; tributaries such as Steamboat Slough; and along the Feather, Bear, Yuba, and American Rivers; Sutter and Yolo Bypass; and smaller tributary streams.

First Phase

Construction, consisting of 430,000 linear feet of levee riprapping, was completed from 1960 to 1975 between Collinsville (river mile 0) and the ends of the project levees (river mile 176 east bank and river mile 184 west bank). Some revetment was also placed on sloughs in the Sacramento-San Joaquin Delta below river mile 40 and on lower tributaries such as the American, Bear, and Feather Rivers.

At the time of construction, no provisions within the project authorization required mitigation. Initially, construction activities were conducted to minimize impacts to the extent possible, and in 1986 the Corps was authorized to provide mitigation to compensate for habitat affected during the first phase of construction.

Subsequent to construction, the U.S. Fish and Wildlife Service prepared a report entitled "Fish and Wildlife Management Plan for Sacramento River Bank Protection Project, California" which listed project impacts as follows: loss of 180 acres of riparian habitat; alteration of 456 acres of riparian habitat due to construction; loss of 3,700 acres of agricultural land adjacent to construction; loss of 80 miles of streambank habitat for aquatic mammals and fish; and unquantified habitat losses for several endangered or rare species. The FWS concluded that acquisition and replanting of 668 acres of riparian vegetation were required to mitigate for first-phase impacts. Following a comparative analysis of without-project and with-project conditions, the Corps, although supporting the concept of providing the 668 acres, identified only 260 acres which were justified as mitigation. The remaining 408 acres were classified as enhancement, since they existed in areas where Federal and State regulations required vegetation removal under normal maintenance of the levee system.

With close cooperation of the FWS and The Nature Conservancy, acquisition of the 260-acre linear riparian vegetation recovery corridor for riparian vegetation plantings was initiated in 1990 is scheduled for completion in 2001. The first parcel of 100 acres near river mile 192.4 was purchased by The Nature Conservancy and was planted in the spring of 1991; the project completion date is 1997, including the 3-year maintenance period.

Second Phase

The second phase of the project was authorized in 1974 and allowed for construction of 405,000 linear feet of bank protection work within the Sacramento River and its sloughs and tributaries. This act also provided that an estimated 10 percent of total construction costs be spent on measures to mitigate adverse environmental impacts.

About 320,000 linear feet was constructed or under construction on August 4, 1989, when the emergency rule of the National Marine Fisheries Service (NMFS) listing the winter-run chinook salmon as a threatened species was published in the Federal Register. At that time, further construction was delayed pending the outcome of State and Federal endangered species consultations.

Part 1 of the Sacramento River Bank Protection Project Second Phase provided approximately 180,000 linear feet of rock revetment. Although a specific acreage target was not developed by the FWS for environmental mitigation within Second Phase Part 1, the resource agencies recommended that 10 percent of construction costs be spent (1) to protect as many acres of riparian vegetation as possible using Right 8 easements or (2) to save as many trees as possible using rockfill instead of bank cutting in preparing the revetment slope. As a result of these measures, 77 acres of berm was protected by rockfill, and 231 acres of easement was acquired.

An additional 225,000 linear feet of bank protection is proposed for Part 2 of the second phase of the bank protection project. The first contracts within the Second Phase Part 2 followed the outline of Part 1, 10 percent construction costs to be spent for providing easements and rockfill as mitigation techniques. Subsequent contracts provide mitigation on the basis of habitat-based analysis and provide for mitigative features including fish groins; experimental bank swallow habitat; riparian vegetation replanting; construction of berms or dredged berms; acquisition of easements or fee title; and the development of wetland habitats. To date, over 250 acres has been acquired as easements, and approximately 70 acres have been purchased in fee.

Third Phase

This project is currently in the planning phase and has not been authorized for construction.

YUBA RIVER BASIN INVESTIGATION

The reconnaissance study was completed in March 1990. Of the proposed alternatives investigated in the reconnaissance study, levee raising along the Feather and Yuba Rivers to provide at least a 150-year level of flood protection was found to be feasible. Detailed feasibility-level studies were initiated in September 1991. A draft feasibility report and EIS are expected to be completed in late 1997. Levee raising, if authorized, would take place primarily on the landward side of the levees, affecting primarily agricultural and grassland habitats. Detailed environmental analysis and mitigation studies will be conducted for the EIS.

These enhancements would provide the Yuba River study area with protection above the current design of the system. As a result, floodwaters which might otherwise cause levee failure and extensive flooding in the study area would be contained within the system and conveyed downstream. To the extent that these downstream flows would compromise the integrity of the existing system below the study area, these adverse hydraulic impacts would have to be addressed to determine if mitigation would be required as part of the project.

For example, it is currently believed that the Sacramento metropolitan area could withstand a 200-year storm on the Sacramento River because projected levee failures in the Yuba and Feather River area would allow massive volumes of floodwater to leave the system, thereby reducing the stage of the flood at the Sacramento-Feather River confluence and allowing the peak flow of the storm to pass by Sacramento without any levee failure. (See discussion in appendix K, Hydrology, of the 1991 ARWI Feasibility Report). If the levee work contemplated as part of the Yuba River Basin Investigation results in 200-year flows being contained within the system, then these flows could raise the stage of the flood at the Sacramento-Feather River confluence enough to cause levee failure along a portion of the system protecting metropolitan Sacramento.

LOCAL TRIBUTARY PROJECTS

Portions of the Sacramento urban area are subject to flooding not only from the Sacramento and American River channels, but also from a series of tributary streams which form their own distinct flood plains. The three principal streams of concern in this regard are (1) the Morrison Creek Stream Group, which threatens portions of south Sacramento; (2) Magpie Creek, which is capable of flooding areas of north Sacramento; and (3) Dry Creek, which threatens the town of Rio Linda and the Cherry Island area of Sacramento County. To address these flood problems, a series of local tributary projects is contemplated.

South Sacramento Urban Levees and Tributaries Project

The South Sacramento Urban Levees and Tributaries project would provide increased flood protection to people and property subject to flooding from the Morrison Creek Stream Group. This group of waterways includes Morrison, Laguna, Unionhouse, and Elder Creeks. Morrison Creek drains an area of about 100 square miles upstream from its confluence with Laguna Creek. The creek has an extensive flood plain both upstream and downstream from this confluence. The creek is confined by levees and occupies a broad floodway as it flows through the bufferlands surrounding the Sacramento Regional Wastewater Treatment Plant. Morrison Creek then flows south into Beach, North Stone, and South Stone Lakes before entering the Sacramento-San Joaquin Delta through Snodgrass Slough and the Mokelumne River. Morrison Creek flows year-round and supports riparian vegetation, wildlife, and a warmwater fishery.

Laguna Creek drains an area of 47 square miles above its confluence with Morrison Creek in the bufferlands around the wastewater treatment plant.

Elder Creek runs generally parallel to the upper reaches of Morrison Creek. Elder Creek is tributary to Morrison Creek in its lower reaches. Much of the Morrison Creek flood plain is at a lower elevation than the Sacramento River. Two pump stations remove floodflows and summer low flows from the flood plain and discharge them to the Sacramento River. This prevents excessive buildup of floodwaters and also allows seasonal agricultural use of the flood plain lands.

Continued development in areas drained by the stream group may exacerbate existing flood problems in urbanized portions of the stream group flood plain, including much of southwest Sacramento and the Pocket area of the city. The City and County of Sacramento are negotiating a Memorandum of Agreement that would encourage new development in the flood plain to control runoff and eliminate further worsening of flood problems in the future. The city envisions three projects to increase the level of flood protection to property in these areas from existing flooding conditions:

- Immediate Urban Levees Project. This project would include stabilization and raising of the west/north Morrison Creek levees and would provide protection to southwest

Sacramento and the Pocket area. This work would be done as maintenance of the existing levees on the landward side. Most of the work will be accomplished on top of existing levees or landside stabilizing berms.

- Elder and Unionhouse Creeks, California, Section 205. Under this project, channel and levee improvements would be made on Elder, Unionhouse, and lower Morrison Creeks with Corps, State, and local funding. The Corps is currently studying this project under its Section 205 continuing authorities program.

- Morrison Creek Stream Group, California. The city has also requested that a new general investigations study of the rest of the Morrison Creek Stream Group, including Elder, Unionhouse, Strawberry, and Florin Creeks, be conducted by the Corps under the Northern California Streams authority.

With these projects, raising or constructing levees and modifying channels to improve flow of floodwaters is anticipated. Exact areas of impact have not been identified. Some losses of riparian and wetland habitats will be inevitable in these types of projects. However, all three projects are being conducted in accordance with NEPA or CEQA guidelines and will seek to minimize impacts or fully mitigate unavoidable losses of habitat.

Magpie Creek Diversion Channel Improvement Project

This project would control flooding in the north Sacramento area of the city and portions of McClellan Air Force Base. Magpie and Don Julio Creeks are intermittent streams which originate east of McClellan in Sacramento County. Both Magpie and Don Julio Creeks originate north of I-80. The two creeks flow west through McClellan and presently join upstream from the Magpie Creek Diversion Channel. The combined flows are conveyed through the diversion channel to Robla Creek, which is tributary to Dry Creek, and thence into the NEMDC. On McClellan, a lateral canal between the two creeks permits some equalization of flows in the two creeks and forms a common flood plain.

Urban development in the watershed, including development and channelization within McClellan, has increased peak runoff and flood volume to Magpie Creek and the existing diversion channel, thereby increasing the flood hazard to the area. Increases in runoff are due to the decrease in the amount of land available to store floodwater and to absorb rainfall and runoff resulting from urbanization.

The Corps has completed a reconnaissance-level report for Magpie Creek under the Section 205 authority and expects to complete a feasibility level study by mid-1996. The potential plan for this area involves channel modifications and levee construction from the confluence of the existing Magpie Creek Diversion Channel and Robla Creek near Vinci Avenue. A new flood control channel would be constructed from that point to connect to Magpie Creek at Patrol Road on McClellan. Additional flow deflectors would be constructed on the levee.

Potential impacts include the loss and/or degradation of riparian and freshwater marsh, vegetation, grassland habitat, woody riparian habitat, and herbaceous riparian vegetation within the project area. These losses could affect roosting and nesting practices and breeding, feeding, and resting habitat for birds, small mammals, amphibians, and reptiles. However, vernal pools that lie near the proposed project area will be protected from impacts during channel and access road construction. Mitigation for disturbed habitats would be provided by developed wildlife habitat on portions of McClellan.

Dry Creek Flood Control Project

This project would control flooding in the Dry Creek flood plain. The town of Rio Linda, as well as other areas along Dry Creek, is subject to frequent flooding because Dry Creek lacks adequate channel capacity to convey large floodflows. Hydrologic and hydraulic studies completed by the Corps have determined that Dry Creek is capable of carrying the runoff of about a 5-year frequency storm event. During the February 1986 flood, approximately 2,000 acres of the Dry Creek flood plain below the Sacramento County line experienced extensive flooding.

This flood problem is complicated by the fact that Dry Creek splits into two small branches above Rio Linda. When flows exceed the existing channel capacity, the total area between these branches becomes inundated. This area is referred to as Cherry Island. Numerous residential, commercial, and industrial structures are located in the Dry Creek flood plain along with several bridges and streets which become impassable during flooding. Thus, businesses and residences can be disrupted for up to several days and can be damaged. The reach of Dry Creek subject to the most severe flood damages is about 3 miles long and extends from Marysville-Rio Linda Boulevard to north of Dry Creek Road.

SAFCA is investigating alternatives to provide adequate protection (100-year flood protection) to people and property in the Dry Creek flood plain. Based on preliminary engineering analysis and study, SAFCA developed a concept plan that includes a new leveed channel that bisects the existing flood plain which could protect the town of Rio Linda and its main transportation arteries (Elkhorn Boulevard and Dry Creek Road) from being inundated during a 100-year flood. The new channel and levees would extend about 2 miles and would consist of an earthen trapezoidal channel with a bottom width of about 200 feet and an average depth of 15 feet. The levee would have a top width of 20 feet with sideslopes of 2 to 1 on the landside and 3 to 1 on the waterside. The channel and levees would be located to avoid or minimize removal of any vegetation, particularly mature stands of trees. New bridges would be required at Dry Creek Road and Elkhorn Boulevard. Environmental clearance in accordance with CEQA will be obtained prior to construction.

NATOMAS AREA FLOOD CONTROL IMPROVEMENT PROJECT

The Natomas Area Flood Control Improvement Project was approved for construction with local funding by the Sacramento Area Flood Control Agency in June 1993. The

project, referred to herein as the "Approved Local Project," is designed to provide the Natomas Basin with more than a 100-year level of flood protection independent of any improvement in flood control capability along the American River upstream from Natomas. The Approved Local Project would also protect portions of the North Sacramento, Rio Linda, and Elverta communities by controlling high flows in the lower Dry and Arcade Creek watersheds and by reducing flood stages in the Natomas East Main Drainage Canal (NEMDC) north of Dry Creek.

Elements of the Approved Local Project, which have been modified as the project planning process has moved through the final design stage and into construction, are described below.

Natomas East Main Drainage Canal

Raise portions of the east and west levees a maximum of 3.5 feet. The west levee raise would extend from the pump station north of Dry Creek to approximately 1,700 feet south of West El Camino, and the east levee raise would extend from the existing Robla Creek levee to approximately 2,000 feet south of West El Camino. Stoplog structures would be constructed at the east and west ends of the El Camino Avenue bridge crossing of the NEMDC.

Main Avenue Bridge

Construct a temporary stoplog structure at West Main Avenue until funding is available to construct a new four-lane high-level bridge across the NEMDC and Union Pacific Railroad.

NEMDC Pumping Plant

Construct a large pump station and gated control structure across the NEMDC near the mouth of Dry Creek. The structure housing the pumps will be 30 feet high and provide approximately 10,000 square feet to accommodate three 333-cfs diesel pumps.

Arcade Creek

Raise the north levee between the NEMDC and Marysville Boulevard a maximum of 2 feet to match the top elevation on the south levee and ensure low points are not left in upstream reaches. Using a combination of earthfill and floodwall, raise the south levee west of Marysville Boulevard a maximum of 3 feet for a 500-foot reach. Construct stoplog structures at the north and south ends of the Norwood Avenue bridge crossing of Arcade Creek and at Rio Linda Boulevard, or tie the levee or floodwall at Rio Linda Boulevard into the existing concrete bridge rail.

Dry\Robla Creek

Construct a new levee with a maximum levee height of 12.5 feet extending from the pump station along the Union Pacific Railroad, Ascot Avenue and 4th Street to high ground east of Rio Linda Boulevard. Raise the existing south Dry\Robla Creek levee a maximum of 8 feet across Rio Linda Boulevard north of Claire Avenue. Rebuild Rio Linda Boulevard along the top of the proposed levee and extend the existing levee east of Rio Linda Boulevard to the confluence of Robla Creek and the Magpie Creek Diversion Channel at a maximum height of 11 feet.

Pleasant Grove Improvements

Raise the PGCC (Pleasant Grove Creek Canal) west levee and Howsley Road by 1.5 feet to fill low spot in the levee. Construct a stoplog structure and retaining wall at the west end of the Fifield Road Bridge and leave the existing bridge unmodified. Reinforce the PGCC levee where the levee intersects Sankey Road.

When funding permits, raise the PGCC levee approximately 5 feet where the levee intersects Sankey Road and implement the following measures to create a detention storage basin covering approximately 1,000 acres of farmland east of the PGCC and west of the UPRR (Union Pacific Railroad) between Howsley and Sankey Roads. Construct a new levee along the north side of Sankey Road across the UPRR to the intersection of Pleasant Grove Road. Install three closure structures in the Sankey Road levee at the UPRR crossing and at farmstead access roads east and west of the UPRR. Install culverts with flap gates on the southerly end through the levee and under Sankey Road and extend the existing NEMDC channel to receive floodwaters discharged through the culverts. Construct a levee along the south side of Howsley Road from the bridge at the PGCC east to the UPRR and install 10 culverts with flap gates through the levee to receive floodwaters from lands to the north. Breach existing wing levees west of the UPRR at Pleasant Grove Creek, Curry Creek Pierce Roberts Drain to the minimum extent required for inundation of the detention basin. Remove the abandoned Sacramento Northern Railroad embankment south of Howsley Road to a point just north of Sankey Road.

Natomas Cross Canal

Raise the existing south levee east of the Garden Highway to approximately State Highway 99.

American River North Levee

Raise a 200-foot reach of the American River north levee (the Garden Highway) between 0.0 and 0.5 feet by means of building up the existing asphalt pavement. Construct a stoplog structure on the north side of the Northgate Boulevard NEMDC bridge approach. Construct additional stoplogs at the UPRR track west of Del Paso Boulevard.

SIGNIFICANT ACTIONS SINCE 1992

The following actions subsequent to the 1992 legislative session have affected the scope and nature of the Corps' response to Congress' call for a reevaluation of the American River project: (1) SAFCA's start of construction of the Natomas features of the project with local funds (SAFCA Local Project); (2) execution of a 5-year agreement between SAFCA and Reclamation to modify the operation of Folsom Reservoir (Interim Reoperation); (3) initiation of a bank protection project affecting up to 9,100 lineal feet along critical reaches of the lower American River under the authority of the Sacramento River Bank Protection Project (Lower American River Bank Protection Project); and (4) initiation of a regional water study, the American River Water Resources Investigation by Reclamation in conjunction with Sacramento, Placer, El Dorado, and San Joaquin Counties; and Wild and Scenic Rivers and National Recreation Areas eligibility studies. These actions and their effect on the Corps plan formulation process are discussed below.

SAFCA LOCAL PROJECT

This project, which was described in more detail in the previous section, received a Department of the Army permit in June 1993 and will provide the Natomas basin and portions of the lower Dry and Arcade Creek watersheds with 100-year or greater flood protection. The project is designed to accommodate flows in the lower American River up to 180,000 cfs and is thus compatible with the main stem American River alternatives being evaluated in connection with the ARWP. Nevertheless, the project does not depend on any upstream improvements to remove the protected areas, including the Natomas basin, from the regulatory flood plain. These project improvements and the direct and indirect (growth-inducing) impacts caused by the project are fully described in the Final Environmental Impact Report for the Revised Natomas Area Flood Control Improvement Project (Final EIR) and the supplemental environmental documents issued in connection with the Final EIR which are available through the SAFCA office at 1007 Seventh Street, Fifth Floor, Sacramento, California 95814.

INTERIM REOPERATION

This project was implemented by agreement between SAFCA and Reclamation in February 1995. The implementing agreement requires Reclamation to operate Folsom Reservoir during the flood season in accordance with a flood control diagram (1993 Diagram) designed to reduce the probability of flooding by levee failure to a 1 in 100 chance in any year. The 1993 Diagram ties Folsom Reservoir storage to storage in the three largest non-Federal reservoirs in the American River watershed: Union Valley, Hell Hole, and French Meadows. When these reservoirs have between them at least 200,000 acre-feet of space available for flood storage, Folsom may store up to 575,000 acre-feet of water, reserving at least 400,000 acre-feet of empty space for flood storage as

required under the Corps 1986 flood control diagram. When the upstream reservoirs fill so that less than 200,000 acre-feet of space is left for flood storage, Folsom Reservoir must be drawn down to compensate. When the upstream reservoirs are full and no space is available for flood storage, Folsom may store no more than 305,000 acre-feet of water, reserving 670,000 acre-feet for flood storage. To protect the environmental and recreational resources in the lower American River, the Interim Reoperation implementing agreement further obligates Reclamation to ensure that Folsom Reservoir releases during the spring refill period are at least equal to the lesser of (1) the releases that would have been made if Folsom had continued to be operated in accordance with the 1986 Diagram or (2) the releases designated by Judge Hodge in deciding the matter of Environmental Defense Fund et al. versus East Bay Municipal Utility District (Hodge flows).

The implementing agreement obligates SAFCA to mitigate the potential adverse impacts of this changed operation. These impacts include reduced CVP water deliveries, reduced CVP power generation, increased power costs for local water agencies taking deliveries directly from Folsom Reservoir, reduced reservoir recreation opportunities, increased exposure of shoreline cultural resources to damage, and increased temperatures potentially harmful to the fishery in the lower American River. The agreement anticipates that this mitigation will generally take the form of annual payments for replacement of the lost or expended resources. However, SAFCA has undertaken two significant permanent improvements in connection with Interim Reoperation: (1) modification of the shutter system which controls the elevation (and therefore the temperature) of releases through the main dam and (2) boat ramp extensions in the Hobie Cove/Brown's Ravine area to permit access to the reservoir at the lowest water-surface elevations required under the 1993 Diagram.

SACRAMENTO RIVER BANK PROTECTION PROJECT, LOWER AMERICAN RIVER

The Corps of Engineers and The Reclamation Board in cooperation with the Sacramento Area Flood Control Agency are proposing to construct streambank protection on the lower American River under the Federally authorized Sacramento River Bank Protection Project. The purpose of the streambank protection is to protect the integrity and reliability of Federal flood control levees, while preserving existing environmental values and the wild and scenic recreational status of the lower American River and parkway.

Bank protection is proposed under the currently authorized Sacramento River Bank Protection Project because (1) immediate actions are necessary at sites to reduce the threat of levee failure, (2) an existing authorized project can address these critical sites, and (3) bank protection is needed on the lower American River regardless of what alternative is selected by the American River Watershed Investigation.

Since January 1994, the Lower American River Task Force, composed of flood control agencies, resource protection agencies, and local interest groups, has been developing a locally-preferred erosion control plan for the lower American River which includes

streambank protection measures to reduce the immediate and future risks of levee failure. The plan for managing bank erosion developed by consensus among the Task Force participants comprises immediately needed streambank protection at four critical sites of streambank and bank protection needed for the longer term. The immediate bank protection is proposed for construction in 1997. Longer term streambank protection may be needed at any location along the Federal levee system where levees become threatened by erosion. Potential sites have been identified that may become critical in the future. Other sites may be identified from future flood events.

The designs for streambank protection developed by the Task Force are intended to preserve and recreate as much aquatic and riparian habitat values and visual quality as feasible. Designs contain well-vegetated, visually irregular surfaces composed of rock, soil, and biotechnical materials. Large, woody material is proposed along the shoreline, and marsh and riparian vegetation would be established on the streambank protection structure.

A Supplemental Draft Environmental Impact Statement/Environmental Impact Report is scheduled to be distributed for public review and comment in the spring of 1996. This environmental document will assess the environmental effects of the Task Force's locally preferred streambank protection project and alternative plans.

AMERICAN RIVER WATER RESOURCES INVESTIGATION

The American River Water Resources Investigation (ARWRI) was initiated in the fall of 1991 under the authority of the American River Basin Development Act (Public Law 81-356). It is being organized by the Bureau of Reclamation. Federal funding is available on a year-to-year basis through the House Appropriations Committee, provided 50 percent matching funds are contributed in equal shares by the non-Federal sponsors of the study—the Sacramento Metropolitan Water Authority, the American River Authority, the San Joaquin Flood Control and Water Conservation District, and the Sacramento County Water Agency (in partnership with the City of Sacramento). The purpose of the investigation is to identify significant water resource needs within the American River study area, formulate alternative plans to meet those needs, and determine a preferred alternative. The study objectives are to (1) manage ground-water basins and surface-water supplies to maintain beneficial uses and to protect water quality; (2) provide water to meet projects (year 2030) water demands, including municipal industrial, and agricultural needs; (3) provide flows sufficient for water-oriented recreation; (4) sustain riverine and associated biological environment; and (5) be consistent with ongoing activities addressing flood protection needs. The study is proceeding in four phases. Phase one consists of identifying water-related needs by examining existing systems. This phase was complete in February 1995. Phase two consists of plan formulation, analysis, evaluation, and identification of a preferred plan. Reclamation completed this phase in July 1995. Phase three, in which Reclamation will determine the feasibility of the preferred plan, prepare a Planning Report and Draft Environmental Impact Report/Environmental Impact Statement, and circulate this document for public review and

comment, is due for completion in 1996. In phase four, public comments will be addressed, and a final report will be prepared and then submitted for a decision by Congress in 1996.

As part of the NEPA document prepared for this project, Reclamation has made determinations on how the river would be affected under each of its alternative plans and how the river reaches Suitability for Inclusion in the Wild and Scenic Rivers system. The alternatives which permanently impound water behind a dam would make the reaches flooded unsuitable for inclusion in the system.

IMPACTS OF EXPANDING THE FLOOD DETENTION DAM TO A MULTIPURPOSE FACILITY

The Detention Dam Plan was formulated to neither promote nor preclude expansion for permanent water storage at the Auburn site. Expansion to a multipurpose dam project with a permanent pool would significantly increase vegetative losses, geomorphological changes, and related impacts over those identified for the Detention Dam Plan.

A multipurpose project could be implemented in at least two ways: (1) construction of a multipurpose facility independent of flood control proposals on the American River (authorized and built instead of flood-control-only facilities or at a different location from the proposed flood detention dam) or (2) expansion of a flood-control-only dam sometime in the future. This section highlights the features required to expand a proposed flood control project to a multipurpose dam and summarizes the potential impacts of a large multipurpose dam under either method of authorization. This discussion draws heavily on the previous environmental work completed by Reclamation for the full-sized multipurpose Auburn Dam.

The detention dam has been designed to neither promote nor preclude subsequent expansion of the facility into a multipurpose project providing permanent water storage and related water supply, hydropower, flatwater recreation, and instream flow benefits. Such an expansion would require separate congressional action based on appropriate environmental review of the impacts of permanent water storage in the project area. .

BACKGROUND

The Auburn-Folsom South Unit of the Central Valley Project was authorized in 1965 under Public Law 89-161 for construction by Reclamation. Included among its features were the Auburn Dam and Reservoir on the North Fork American River upstream from Folsom Reservoir. The dam, as originally proposed, would have impounded a reservoir with a gross pool storage of 2.3 million acre-feet, inundating over 10,000 acres, and providing benefits for water supply, hydropower, recreation, fish and wildlife, and flood control.

Construction of the dam was suspended in 1975 following a 5.7 Richter magnitude earthquake at Oroville, California. Although seismic studies indicated that the probability of

a major earthquake (6.0 or greater) at the Auburn site was relatively low, and the planned double curvature, thin-arch design was believed capable of withstanding such an event should it occur, the design was replaced with a concrete gravity design. Construction was not restarted because of changes in Federal policy on cost sharing and vigorous opposition from environmental groups. Under current cost sharing policy, the non-Federal project sponsor must pay, at the time the project is constructed, the cost of all hydropower and municipal and industrial water supply features.

ACTIONS REQUIRED TO EXPAND A FLOOD-CONTROL-ONLY DAM TO A MULTIPURPOSE FACILITY

Expansion of a flood detention dam into multipurpose facility providing water supply, power generation, and recreation in addition to flood control would likely require (1) additional engineering and environmental study and documentation; (2) significant physical modifications; (3) additional congressional authorization; and (4) identification of non-Federal cost-sharing partners.

Reconnaissance-level cost estimates of a 2.3 million acre-foot multipurpose dam are in excess of $1.7 billion. The expansion of the flood detention dam to a multipurpose facility would trigger a reallocation of costs among the project purposes. The reallocation would most likely be implemented using the principles of the Separable Costs-Remaining Benefits methodology.

The major physical modifications to the flood control facilities include:

- Additional foundation work and grouting.
- Additional concrete and related structural elements to raise and widen the dam to the desired crest elevation.
- Construction of outlet works.
- Construction of a generating plant and electrical transmission facilities.
- Reconstruction of the emergency spillway.
- Installation of regulatory gates on the spillway.
- Construction of recreational facilities.
- Acquisition of additional lands for the project features and mitigation.
- Implementation of a plan to mitigate impacts on environmental and related resources.

The Detention Dam Plan wold not alter the original authorization for Reclamation's Auburn Dam Project. For example, the Federal ownership of lands in the inundation zone would not be affected. All fee land required for the Detention Dam Plan (except those required for environmental mitigation) would be acquired by joint-use permits. The non-Federal sponsor would obtain flowage easements from the Federal landowners within the inundation zone. Any future disposition of lands would have no effect on the flood control project. Congress could then determine the disposition of those lands outside the inundation

zone, independent of the flood control project. These lands could be retained for a future multipurpose dam or a Federal recreation area.

Under applicable Federal planning principles and guidelines as well as congressional policies, a multipurpose project could not proceed at the Auburn site without being redesigned, subjected to environmental review, and reauthorized by Congress. This would be true whether the redesigned project provided for converting or expanding the flood detention dam or for constructing a new dam in a different location. Since such review and reauthorization would be required even without a flood detention dam, implementation of the Detention Dam Plan would not impose any new procedural requirements on the multipurpose project or avoid any requirements which would otherwise apply (CEQA Guidelines, Section 1502.9).

ENVIRONMENTAL IMPACTS

This section discusses the impacts that would result from the expansion of a detention dam into a multipurpose project (assuming that design plans for such an expansion are completed and authorized by Congress). The discussion focuses primarily on the expected direct project impacts of the 2.3 million acre-foot reservoir analyzed by Reclamation. Smaller multipurpose reservoirs have been studied by Reclamation and DWR. However, consideration of the largest feasible structure would maximize impacts and, therefore, represent a worst-case scenario.

Fish and Wildlife

A 2.3 million acre-foot reservoir, with a maximum water-surface elevation of 1,135 feet, would permanently inundate over 10,000 acres of river canyon and 48 miles of mostly free-flowing stream. By comparison, the flood-control-only dam, with a maximum water-surface elevation of 942 feet above sea level, would temporarily inundate up to 5,450 acres of canyon and approximately 40 miles of stream. The maximum inundation has less than a 1 in 500 chance of occurring in any year (table 10-2).

Mapping by FWS in 1989 showed that the predominant cover types within the respective flood storage pools of both the dry dam and multipurpose dam include north slope oak woodlands, south slope oak woodlands, chaparral, coniferous forest, grasslands rocky/ruderal, and riverine/riparian habitat.

Based on the total acres of each cover type inundated by the large reservoir, it is estimated that the large reservoir would increase the loss of habitat within the north slope oak woodlands by 3,503 acres over the Detention Dam Plan, increase the loss of south slope oak woodlands by 3,537 acres, increase the loss of chaparral by 591 acres, increase the loss of coniferous forest by 657 acres, and increase the loss of grasslands by 556 acres (table 10-2).

TABLE 10-2

Comparison of Habitat Losses Between Projects[1]

	North Slope Oak Woodland	South Slope Oak Woodland	Chaparral	Coniferous Forest	Grassland	Montane Riverine	Total
Acreage Losses Attributable to Project Construction and Operation							
Multipurpose reservoir	4,034	4,068	653	729	757	NA*	10,241
Flood detention dam	435	627	62	72	201	136	1,533
Difference	3,599	3,441	591	657	556	136	8,708

[1]Modified from FWS, 1990
*NA - Not available

The flood detention reservoir would be expected intermittently to inundate approximately 40 miles of the North and Middle Forks of the American River during about a 400-year storm. The large reservoir would permanently impound 48 miles of stream. Notwithstanding Lake Clementine in the North Fork, the large reservoir would result in converting a free-flowing riverine fishery to a flat-water lake fishery. The flood detention reservoir would maintain existing stocks of warm and cold water species, such as rainbow trout, brown trout, smallmouth bass, Sacramento squawfish, and Sacramento sucker. The large reservoir would tend to favor sunfishes, largemouth bass, smallmouth bass, and catfish. However, species compositions and populations would be highly dependent on stocking programs implemented by DFG.

The multipurpose reservoir project could provide benefits to the regional fishery by dampening the water-level fluctuations in Folsom Reservoir and providing additional coldwater storage capacity to enhance natural production of steelhead trout and chinook salmon in the lower American River. The magnitude of these potential benefits would depend upon operating procedures and the amount of water storage allocated to these purposes.

Recreation

As described in previous sections, the estimated visitation in the upper American River canyons is approximately 500,000 persons annually. The flood detention dam is not expected to change the type, location, or quality of recreation in the upper American River basin, with the exception of visual resource impacts which are discussed in chapter 9. In addition, visitation is not expected to be significantly affected during flood operations because such events would be infrequent, of relatively short duration, and would occur during off-

peak season when visitation is less than 10 percent of annual use. Inclement weather would be associated with flood operations and would normally inhibit off-season visitation with or without an impounded flood pool.

In contrast, a large multipurpose reservoir would significantly alter recreation in the canyons. River-dependent or river-enhanced recreation would be replaced by reservoir-dependent recreation. Within the 48 miles of permanently inundated river channels, unique activities such as whitewater rafting and recreational gold mining would be eliminated. Because of the scarcity of whitewater rafting reaches in California, this would be considered a significant impact. Of the existing 72 miles of equestrian, hiking, and biking trails, 58 miles would be inundated. The Auburn Project General Plan calls for the development of 120 miles of riding and hiking trails. If constructed, the trails would generally be located a away from the lakeshore due to the steep canyon topography.

Approximately 100 existing primitive campsites would be lost due to inundation. However, park development plans indicate that these would be replaced with 280 developed campground sites, including 5 trail campgrounds and 6 boat-in campsites.

Stream fishing would be supplanted by reservoir fishing with a higher dependence on motorized boating, which would limit fishing opportunities to those with such boats.

A large permanent reservoir could provide additional opportunities for motorboating, sailboating, waterskiing, jetskiing, and other reservoir-dependent activities. The California Department of Parks and Recreation has projected that approximately 2,400 acres of the large reservoir would be reserved for nonpower boating and 3,400 acres would be reserved for waterskiing and powerboating; restricted speedboating would be allowed on 4,200 acres (BLM, 1990). The reservoir would have a design capacity for 117 boats in the ski zone and 145 boats in the restricted speed zones. However, the large multipurpose reservoir is expected to fluctuate by as much as 300 vertical feet during drawdown, which is expected to decrease the surface area of the lake to 4,000 acres and reduce boat capacity by 60 percent.

Reclamation anticipated that facilities would be provided at the large reservoir to accommodate 2 million visitor days annually and sufficient land to accommodate 5 million visitor days. The character of the recreation experience would change from wilderness/semiwilderness to developed recreation. The change would likely be considered a significant loss due to the scarcity of semiwilderness areas that are close to major metropolitan areas and are easily accessible by major roadways. In contrast, several reservoirs within the basin and within reasonable driving distances provide recreation opportunities similar to those that would be provided by a large multipurpose reservoir.

A large reservoir could potentially enhance recreational experiences in Folsom Reservoir by stabilizing pool levels and in the lower American River by providing higher sustained releases. However, the magnitude of these potential beneficial effects would depend on specific operational procedures.

Water Quality

Construction of a permanent reservoir would result in short- and long-term changes in water quality. After initial filling, new reservoirs undergo several years of biological and chemical change resulting from the decomposition of flooded organic matter (Gunnison et al., 1986). Nutrients, such as phosphorus, nitrogen, and trace metals, enter the reservoir by four primary means: (1) leaching and physical separation from mixed soils and organic debris; (2) leachate and particulate matter from submerged terrestrial vegetation; (3) inflow from the drainage basin; and (4) drowned terrestrial animals (Ploskey, 1981). The increase and bioavailability of nutrients and detritus accelerate the rate of biological productivity for periods of 5 to 10 years, which, in turn, increases the biochemical oxygen demand and depletes concentrations of dissolved oxygen. As the reservoir ages, water quality gradually improves.

The multipurpose reservoir would be very deep and would undergo thermal stratification. Stratification results when spring and summer air temperatures warm the upper layers of water (epilimnion) in the reservoir. As the epilimnion warms, it becomes less dense, and a barrier, or thermocline, develops between the cool bottom waters (hypolimnion) and the epilimnion. As a result of this density gradient, dissolved oxygen from the surface cannot diffuse to the hypolimnion. Concurrently, decomposition of organic matter in the hypolimnion exhausts residual supplies of oxygen. These anaerobic (oxygen-deficient) bottom conditions cause the release of unoxidized metals, such as iron, manganese, and phosphorus.

The process reverses in the fall. Surface temperatures cool, become more dense than the hypolimnion, and sink to the bottom, displacing the hypolimnion. This "turnover" results in mixing of epilimnion and hypolimnion, resulting in the sudden availability of nutrients which, in some cases, cause algal blooms. Most of the nutrients released from the bottom materials during summertime anaerobic conditions are taken up by organisms during the fall turnover.

As noted above, a large multipurpose reservoir could potentially enhance water quality in the lower American River by increasing the volume of cooler water released. This would, in turn, increase the concentration of dissolved oxygen. The magnitude of these benefits would depend largely on the volume of water stored for such specific purposes and the operation of the downstream releases.

Water Supply

A principal benefit of a large multipurpose reservoir would be the provision of additional water supplies. Recent estimates by Reclamation (1987) indicate that a 2.3 million acre-foot reservoir would provide long-term firm yields of between 270,000 acre-feet and 350,000 acre-feet, depending on the instream flow schedule maintained. Firm supply is defined as water that would be available even in the most critically dry years as defined by the 7 driest years of historical record.

To put these numbers into perspective, it is estimated that a family of five in California requires approximately 1 acre-foot of water annually for domestic needs. Therefore, the firm yield from such a reservoir would support between 270,000 and 350,000 families per year. In terms of agricultural production, approximately 25 acre-feet of water per year is required for the production of food for a family of five. Therefore, if some combination of supply, demand, taxation, and/or subsidy were to make water from a multipurpose project available to agriculture, then the firm yield from that reservoir would supply sufficient water to produce enough food to support between 10,800 and 14,000 families.

Provision of between 270,000 and 350,000 acre-feet of new water supply annually could be growth-inducing in two respects. First, additional water supplies would permit increased crop production to feed and clothe new residents, and second, new supplies could be used to meet the domestic water needs of new development.

The amount of new agricultural lands that could be put into production is a function of the specific water demands of the crop. For example, 270,000 acre-feet of water could support production of over 300,000 acres of safflower, but only 42,000 acres of rice. Table 10-3 displays typical water demands of various crops in the Sacramento region and shows the estimates for the crop-specific acreage that could be cultivated with increased water supplies.

The amount of urban development potentially accommodated by additional water supplies also varies as a function of specific land use. For example, 270,000 acre-feet of additional supply could increase urban development between 30,000 acres (high density residential) and 55,000 acres (light industry or commercial) depending on the specific land use category. In a real-time situation, supplies would be allocated to most or all potential uses, but the net effect would be that fallow or undeveloped agricultural lands could be put into production, and undeveloped and/or agricultural lands could be converted to urban uses.

Hydropower

Reclamation estimated that a 2.3 million acre-foot reservoir equipped with a 300-megawatt powerplant would generate about 600 Gwh. Based on average electrical demand rates of 7,200 Kwh for a typical household and 132,000 Kwh for a typical commercial facility of 10,000 square feet, the power generated by the powerplant could supply the power needs for either 84,000 new homes or 4,500 new commercial facilities.

Cultural Resources

The flood-control-only reservoir would periodically inundate 17 prehistoric sites and 163 historic sites in the upper American River. The prehistoric sites are mostly bedrock mortars, and the historic sites are associated with gold-mining activities. These impacts are described in chapter 9.

TABLE 10-3

Potential Increase in Agricultural and Urban Land Uses Based on Additional Water Supplies From a Large Auburn Reservoir[1]

	Annual Water Use (acre-feet/acre/year)	Potential Increase in Acreage
AGRICULTURAL		
Grain	1.4	196,429
Rice	6.5	42,308
Safflower	0.9	305,556
Sugar beets	3.5	78,571
Field corn	3.0	91,667
General field	2.3	119,565
Alfalfa	4.4	62,500
Pasture	5.3	51,887
Tomato	3.1	88,710
Misc. truck crops	1.9	144,737
Deciduous	3.6	76,389
Vineyard	2.9	94,828
LAND USE		
Light industry	5.0	55,000
Office/business	6.2	44,355
Commercial	5.0	55,000
Rural estate	4.5	61,111
Low density residential	8.7	31,609
High density residential	9.2	29,891

[1] Assuming yield of 275,000 acre-feet per year and would be used to meet the water needs for each crop or land use.

The large multipurpose reservoir would permanently inundate approximately 33 prehistoric and 460 known historic sites of all types and various levels of State and Federal significance. Additional consultation with the State Historic Preservation Officer and Advisory Council on Historic Preservation would be required.

GROWTH INDUCEMENT

A detailed discussion of the growth-related impacts of a multipurpose project is beyond the scope of this analysis for two principal reasons. First, the nature of the growth likely to result from an expansion project is not reasonably foreseeable at this time. Second, such an assessment would be exceedingly speculative. Nevertheless, it is clear that lack of available water supply is a constraint to growth in the upper American River area. Expansion of the flood detention dam for multiple purposes could serve to ease this restraint. In that case, more intense development could proceed in the area. As discussed above, if a

multiple-purpose project is undertaken, a full discussion of impacts, including growth-related impacts, would be required.